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CHILD HEALTH
AND DEVELOPMENT

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AND
DEVELOPMENT

BY
VARIOUS AUTHORS

EDITED BY
RICHARD W. B. ELLIS
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PREFACE TO THE FOURTH EDITION

IN the three years that have elapsed since the publication of the third edition there have been a number of significant advances in the study of genetics, physiology of the foetus and newborn infant, child development, and immunity. Recent legislation has modified the procedures relating to children brought before juvenile courts, and a very relevant Government White Paper (referred to in a postscript) has appeared whilst the book was in the press. These various developments have necessitated considerable revision of the text, and a number of sections, *e.g.* those dealing with the genetical aspects of child health, emotional development and juvenile courts have been completely rewritten. New chapters dealing with prematurity, accident prevention, and family planning have been added.

The original arrangement of the book has been retained. It is divided into two parts. The first deals with normal development. The second is concerned with those social agencies having a direct impact on the child. The purpose of the book is to bring together some of the widely scattered information relating to child health, in which a wide variety of disciplines are involved. Each chapter should be regarded as an introduction to its particular subject, intended to provide the basis for further enquiry rather than complete coverage.

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R. W. B. E.

1965.

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INTRODUCTION

THE combination of an exceptionally long period of prenatal development with a long period of postnatal immaturity is a characteristic of human development. The comparatively few mammalian species which have a gestation period as long as forty weeks give birth to young which are relatively more advanced than the human newborn infant, and those which are born in a state of extreme immaturity after a short gestation period attain maturity more rapidly during postnatal life. This prolonged period of human apprenticeship, covering infancy, childhood and adolescence, is the price paid for the development of the highest intellectual skills; physical maturation is delayed to allow time for perfection of other than physical function. It follows from the long period during which the human young is wholly or partially dependent on the mother, that she herself will normally require the protection and support of her mate, and ideally of the extended family, throughout the whole of the child-bearing period. The child's apprenticeship also will be directed first by the mother, subsequently by the mother in partnership with the father, by the immediate family, and finally to an increasing extent by the community of which the child becomes a member. When this apprenticeship is distorted or abused, or the normal chain of participants broken, it cannot be expected that the child will fulfil his potentialities or reach the highest state of development of which he is capable.

Development. If the whole process of development from conception to maturity is regarded as one designed to fit the child for adult status in the community, it is equally important to remember that each phase of development has individual claims and potentialities of its own. As Capon has said, 'The age of childhood would indeed be dull, insipid and unpromising if those responsible for the management of children thought only of ultimate aims.' In fact, the ultimate aims will be defeated unless each successive phase of development is lived fully, healthily and enjoyably as it is reached.

Whilst the foetus in the seclusion of the womb is less accessible to positive benign influences than is the child after birth, it can at least be protected from a variety of harmful stimuli which may jeopardise its survival or hinder its advance. Prevention or treatment of maternal infection and disease, safeguarding the maternal diet, preparation for safe delivery and breast feeding, early recognition of abnormality, and general attention to maternal health and well-being, will all help to ensure successful prenatal development. The process of birth itself, though hardly to be enjoyed by either mother or infant, can be stripped of many of its potential hazards, and become an incident rather than a disaster on the long journey from the uterus to the grave.

Following birth, the newborn infant is still supremely helpless and dependent. It will be more than a year before he can even walk securely, feed himself, or communicate intelligibly with the outside world. Five more years are necessary before he is ready for formal education or can be relied on to protect himself against common hazards, and it is well into the second decade of life before he begins to reach puberty and experience the rapid spurt of growth and emotional development which this entails. A full twenty years are required before he is generally regarded as having attained adult status and even then it is often a further five or more years before he can aspire to economic maturity and parenthood.

If this long period of dependency, for which society is paying increasingly heavily, is to yield maximum future benefits, it must be properly understood and productively employed. Each stage of development must be recognised, respected and fulfilled. Just as the inch-long newborn kangaroo is carried in his mother's pouch, so the human infant should pass from the security of intrauterine life to the almost equally secure maternal environment where he is cherished, protected, and fed, his wants promptly recognised, and his earliest efforts at self-expression and initiative stimulated and encouraged. Where the intimacy of the mother–infant relationship is broken or by-passed, the infant's development inevitably suffers. Spence (1946) has emphasised the sapping of maternal confidence which ensues when an infant is handed over to the charge of others in sickness, and how this may be overcome by encouraging the mother to co-operate in the care of her baby in hospital. The effects of prolonged separation or neglect on the infant are likely to be even more disastrous. Bowlby's study of 'Maternal care and mental health' has shown that children deprived of maternal care in infancy are not only liable to suffer in their own emotional development, but also to perpetuate the deprivation (and all that that entails in future neurosis and ineffectiveness) in their own children. The causes of deprivation are numerous: the child may suffer in his own home through the neglect of parents, the home may be broken or incomplete owing to death, prolonged illness, divorce, eviction, illegitimacy or maternal employment. But whatever the cause, the aim should be to maintain or substitute a valid mother–child relationship, whether through support of the family, fostering, adoption, or other means (see Chapter 14). Failing this, the deprived child's retarded emotional development is liable to make him a permanent burden to the community and to himself, and to establish a vicious circle which will prove a continued source of social infection.

The family. Particular emphasis has been placed on the essential quality of the mother–child relationship for the full development of the infant, but the family remains of paramount importance at least during the first five years of life. After that age the child is extending his contacts with the outside world, and will be in a much stronger position to meet adverse circumstances if his early childhood has been secure. Nevertheless the immediate family and extended family group should continue to play an important part throughout childhood in moulding behaviour, providing security, and preparation for adult life.

It would seem that the industrial age has been characterised, first, by a reckless abandon of many of the principles which buttress the family group and so provide for the normal development of the child, followed by a tardy recognition of the consequences and the costly provision of substitutes. Just as the exploitation of child labour in industry (Gordon and Cocks, 1952) left a legacy of disease and inefficiency from which the industrial community took half a century to recover, so the weakening of the family in modern society has been followed by the emergence of the anti-social adolescent and the rootless neurotic. (It has been claimed that greater specialisation has also been responsible for an increasing proportion of misfits in adult life, but this in turn may reasonably be linked with the structure of the family. Spence has pointed out that comparatively few boys now have the opportunity of seeing their fathers at work, or of beginning their apprenticeship as skilled craftsmen in the home.) On the debit side we have the widespread employment of women with young children, the rising incidence of divorce, the uprooting and isolation of individual families from their native community and extended family circle due to rehousing or industrial expansion and the increased tempo of social change, to mention only a few of the factors which undermine the stability of the family. On the credit side we have a degree of material well-being (for half the world) which has probably never been equalled; the opportunity for family planning; a reduction of deaths and control of disease in infancy and childhood which would have seemed incredible fifty years ago. And yet it has been said with good reason that the outstanding event in British social policy in the past ten years has been 'the re-discovery of the family' (Mack, 1955). Painful and costly as the necessity of re-discovery has been, policy has not yet been followed by effective practice. Far too little attention has been given to discovering the causes of family disintegration and to support of the family under stress, compared with the resources which have to be devoted to the results of family breakdown. On the purely materialistic plane, the cost of maintaining a single deprived child in an institution is a poor investment compared with keeping a family together, whilst the amount granted annually for legal aid in divorce proceedings greatly exceeds the financial support given to the recognised marriage guidance organisations.

'The Normal Child'

Any constructive planning of the children's services must be based on some knowledge of the normal development of the children for whom they are planned. The more extensive this knowledge is, the more likely are the services to fulfil the various purposes for which they are designed. A first step was the realisation that the child was not a man in miniature, but an individual passing through successive stages of development, each having limitations and requirements of its own. This has been reflected in legislation, education, hospital care, nutrition, immunisation, care of the underprivileged, etc. But it is almost equally essential to recognise the wide variation which is to be expected between individual children falling within the range of normality. Thus all newborn infants have many features in common, but at the time of birth they already differ from each other in intellectual potential, in physical size, in maturity, and in genetic constitution. With increasing age, many of these differences become more obvious. Whilst we may, in time, so modify environment (or even influence constitution) that each child has the fullest opportunity of fulfilling his potentialities—physical, intellectual, emotional, and spiritual—we cannot (nor should we) hope that the results in every case will be the same. The abstraction of the 'average' child is one to which no single child will rigidly conform; and it is regrettable that it still causes much unnecessary distress to parents whose child fails to match with it in physical growth, in intellect, or in behaviour. In the chapters which follow, the general pattern of development will be traced, but emphasis will also be placed on the *range* of normality.

Once this fundamental principle of normal variation is grasped, we are in a much stronger position to help the individual child. We can in the first place consider what are the requirements of *every* child, whether large or small, dull or brilliant, white or negro. From this we can go on to the special requirements of a variety of sub-groups—male and female, infant and adolescent, those living in a hot or cold climate, and those reared in a particular culture or religious belief. Here we immediately come to controversial ground. Since culture is man-made, it can be altered or adjusted by man. But sudden changes in the structure of a society, although initiated with the best intentions or specifically aimed at improving the welfare of the childhood community, may have quite unexpected repercussions and even do more harm than good. We have only to consider how the impact of Western medicine and industrial methods on Africa and the East are endangering the balance between food-production and world population and weakening the stability and strength of the family (which has been the keystone of African society), to see that manipulation of a culture may be potentially disastrous. It is seldom easy to steer a middle course between a fatalistic acceptance of adverse environment and rash interference, nor with the modern tempo to effect changes sufficiently gradually to allow the necessary readjustments of social structure to be satisfactorily made.

From considering the more general requirements of the childhood community, the next step is to the requirements of the individual child. These will necessarily include the general, but they will also be more specific and more accurately aimed. 'Equal opportunity for all' is an acceptable principle only if we clearly recognise that equal opportunity for optimal growth, development, and fulfilment of each individual is the aim, not the provision of a single open door. Indeed, the ideal 'opportunity' for one may prove a dead-end to another. In the field of education (Chapter 17), much has already been done, and more planned, to make available different channels of educational advancement so that each may develop his capacities to the full. Technical education will prove the best opportunity for one, more academic training leading to a university career for another. The goal, then, is not only that no child should be hindered by poverty, ignorance, malnutrition or preventible disease from reaching the maximum development of which he is inherently capable; but that environment should actively help in this fulfilment of his potentialities. It is equally important that the finished product, the mature, fully-developed adult, should be able to do more than simply exist without friction in the culture in which he has been reared; he should be able to find constructive employment for his capacities and skills, and to pass on the fruits of his long apprenticeship to a future generation.

R. W. B. ELLIS

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PART I

DEVELOPMENT

Chapter I

GENETICAL ASPECTS OF CHILD HEALTH AND DEVELOPMENT

Characters, Chromosomes and Genes

By the geneticist the individual is seen as a constellation of characters, character being the term used to designate any structure, trait or function of an organism whether it be inherited or acquired. The sum total of the characters of an individual, or of a group composed of like individuals, is its phenotype. By the geneticist an inborn, inherited, genetic character, be it a chemical process, a biochemical property, a structural or functional feature or a mental trait, is regarded as the end-result of the action of a gene or of a combination of genes, either alone or else in conjunction with that of some specific factor or factors in the environment of the individual.

The genes, the units of organic inheritance, are, according to classical genetical theory, resident in the chromosomes of the cell-nucleus, being arranged in a precise linear order along the lengths of the chromosomes, each gene having its own particular site or locus in a particular chromosome. Each of the chromosomes carries its own company of genes and so long as it remains intact during its passage from cell-generation to generation the group of genes resident in it will travel together, will remain linked.

The genes contain the information, encoded in their chemical constitution, which is translated into the developmental pattern of the organism. The gene is compounded out of protein and nucleic acid, deoxyribonucleic acid, DNA. In the cytoplasm of the cell are particles composed of ribonucleic acid, RNA, the ribosomes, which are specially concerned in protein synthesis. It seems that from the DNA of the nucleus 'messenger' RNA passes into the cytoplasm there to link up with the ribosomes and to convey to them precise instructions concerning the kind of protein that is to be elaborated and the kind of cell that is to be differentiated. In this way, it is thought, the genes in their actions and interactions with each other and with the rest of the cell-organs, guide the processes of development and of differentiation. The code of information appears to be a non-repetitive ('aperiodic') linear structure in which the items of information are singularities arising from particular sequences, arrangements or configurations along the structure, most probably sequences of nucleotides of four kinds in a polynucleotide chain.

The longitudinal division of the chromosomes during mitosis and meiosis is the direct consequence of the replication of the genes resident within them. Each gene produces a copy of itself and in this way replicas of the original chromosomes are created. But this copying process does not invariably yield a gene identical with the one from which it arose; *mutation*, a specific alteration of the internal organisation of the gene, can occur to yield a new gene, a mutant gene. The two genes, the old and the new, the unmutated and the mutant, form a pair of alleles or allelomorphs. They affect the same developmental processes of the same tissues or organs but yield different end-results, the unmutated gene in its action yielding a 'normal' character, the mutant gene a novel, an abnormal or even a pathological character.

Such spontaneous mutation of any one gene is an exceedingly rare event, but since there are many thousands of genes in the human genetic constitution, the human genotype, and since all of them are prone to mutation, the sum total of mutation is far from negligible. Mutation can be somatic or gametic, the former kind occurring during mitosis, the latter during gametogenesis. The effects of somatic mutation are to be seen in the individual in which it occurred and are restricted to the tissues that stem from the cell in which the copying of the gene was faulty. Since gametic mutation occurs in the germ-track of an individual its effects will be revealed in the progeny of the individual in whom it occurred.

Between the characterisation of a species and the conditions of its habitat there must be harmony if the species is to flourish. Within limits species can choose and modify their environments. Environments change as do also the selective forces within them. Changing environments demand that the characterisation of the species shall be capable of change, of adaptation, of adjustment. Mutation is the device that has provided novelty of all kinds during the evolution of the species. These novelties in characterisation have been exposed to the selective forces in the environment, have been appraised, rejected or encouraged. It is mutation that has made evolutionary movement possible. The present characterisation of *Homo sapiens* (within which there is a wide range of variation) is the product of a very long process of selection during which countless mutant characters have been tested and during which a high degree of harmony between phenotype and physico-climatic habitat has become established. Modern man is more able to modify his environment to match his characterisation than his physical environment is capable of moulding him into conformity with its conditions. As a general rule, mutant characters that now present themselves have to be classified as abnormal, disadvantageous, even pathological for the reason that they tend to disturb, more or less, the equilibrium that has been established between characterisation and habitat. Man's evolution as a biological being seems to have been completed and his further evolution as a psycho-social being to have begun. Mutation seems to have ceased to be necessary or desirable and to have become an impediment to further advancement.

Thus to the geneticist healthiness and normality in development have come to mean the presence in the genotype of the individual of those genes that correspond to, that determine, that are the ultimate causes of, normality. They therefore also mean the absence from the genotype of the alleles of these 'normal' genes that are the causal agents of defect and derangement. Since genes must necessarily function in an environment and commonly act in conjunction with some environmental factor or factors, healthiness and developmental normality mean the presence in the environment of those agents which are either neutral or else actively health-promoting and conversely, the absence from the environment of agents, living and non-living, which in their action, either alone or in conjunction with the action of certain genes, are health-destroying.

Healthiness and normality of development, on the one hand, and genetically-determined disease, defect, derangement and abnormality of development on the other are two distinct and contrasted characterisations based upon entirely different genotypes. The causes of health and normality and of disease and abnormality respectively are different so that health and normality are much more than the absence of disease and abnormality. Since it is far easier to appreciate health and normality by contrasting them with disease and abnormality, far more readily recognised, defined and described, examples of disease and abnormality are used herein to focus attention upon their opposites and alternatives.

The chromosome number characteristic of *Homo sapiens* is 46 or 23 pairs, 22 pairs, the autosomes, common to both sexes, and a sex-chromosome pair, two Xs in the female and an X with a much smaller Y-chromosome in the male. Since the two members of each autosomal pair have identical series of loci arranged in a linear order they are said to be homologous. All Xs have the same series of loci so that the sex-chromosome pair in the female consists of homologous mates. But only part of the X is homologous with the Y so that the X consists of two parts, a segment that is homologous with the Y and a differential segment.

The human chromosome constitution, as it now exists, has been fashioned by the processes of chromosome formation during which independent genes came to be congregated in groups; chromosome fragmentation and union in which new gene associations came into being; deletion, in which a chromosome or a part thereof got lost, failing to become incorporated in a forming daughter-nucleus; translocation, in which a chromosome or a part thereof became attached to another chromosome and inversion, in which a piece of a chromosome became reversed within the chromosome to which it belonged. During the course of the formation of the chromosome complex of man the genes that are female-determining became congregated in the X-chromosome, the male-determining in the autosomes and the Y.

The most remarkable feature of mitosis, meiosis and fertilisation is the precision with which the chromosomal (genic) material is distributed. In mitosis the chromosome content of the daughter-cell is identical with that of the mother-cell from which it arose. In meiosis there is a reduction of the chromosome number to one half, this reduced or haploid set consisting of one member of each of the pairs (the symbol for this haploid number is n). In fertilisation the two haploid sets are brought together, one from each of the parents to yield a $2n$ zygote.

Exceptionally this distribution is faulty. A complete chromosome can become lost and eliminated. When the two members of a pair of chromosomes should separate and pass into the forming nuclei of two daughter-cells they can fail to do so with the result that the nucleus of one of the daughter-cells receives both of them while the other comes to lack this particular chromosome altogether. This failure to separate is known as non-disjunction. Since such aneuploidy (having fewer or more chromosomes than an exact multiple of the haploid number) can result in the production of an abnormal characterisation, healthiness and normality of development come to mean the presence of a normal chromosome constitution. The normal characterisation of the individual is, to a very large extent, based upon, is the expression of, the genotype. There is much genic interaction and the majority of characters have a polygenic, a multifactorial, basis, many genes of individually small effect combining in an additive manner to give the final result. It is not surprising, therefore, to find that the loss of a whole chromosome (and its genes) or of a part thereof and that the addition to the chromosome complex of an extra chromosome or part thereof, can result in a considerable disturbance of the delicate genic balance within the normal genotype and yield an abnormal characterisation.

Dominance and Recessivity

In a pair of loci in a pair of homologous chromosomes there can be two alleles and no more, both of them unmutated or both mutated or one of them unmutated and the other mutated. When the two are of a kind the individual is said to be a homozygote, homozygous for the allele concerned. When the two are different the individual is a heterozygote, being heterozygous for both alleles. Most of the genes in man that have been identified are of this kind, there being two genes, the old and the new, the 'normal' and the 'abnormal'. But a gene can mutate to yield more than two alleles and when this happens the alleles form a multiple allelomorphic series. The ABO blood-group system is an example of this. Of the three genes concerned only two can be present in the genotype of an individual since there are only two loci to accommodate them. None of these three genes is more normal or abnormal than the others. It is not uncommon for one of the alleles of a pair to be dominant over the other. This is to say that when the two are present together in the heterozygote the action of one of them, the dominant one, D, is revealed in the character that comes to be displayed whereas that of the other, the recessive one, d, is not to be discerned. A gene that possesses this property of dominance produces its effects when present in the single dose, in the simplex state; the character based upon it is displayed by the heterozygote, Dd. It is customary to refer to the character based upon a dominant gene as a dominant character. The pedigree that includes an autosomal dominant character shows that it is distributed among the generations in a vertical fashion, the distribution of the character tracing the path of the gene. The individuals who display a dominant character are usually heterozygotes and every individual with the character has one parent also displaying the character. All relatives of an individual with the character who display the alternative recessive character are homozygous for the alternative recessive gene and do not possess the dominant.

Achondroplasia is a typical autosomal dominant character of a pathological kind that is based upon a single major gene in one of the autosomes, its action not being affected by that of any environmental factor. If the gene corresponding to it is present in the genotype of the embryo, the child will inevitably develop into an achondroplastic dwarf. Between the two contrasted characterisations, normality and achondroplasia there are no intergrades, they furnish an example of discontinuous variation.

Autosomal dominant genes, for the most part, do not give rise to very serious defect or derangement; most of the characters based upon them are relatively innocuous and are such as can be repaired, *e.g.* polydactyly, syndactyly, congenital cataract, but to this generalisation there are notable exceptions, *e.g.* retinoblastoma, retinitis pigmentosa (all forms considered together), multiple polyposis of the colon and rectum, Huntington's chorea. The serious aspect of this last condition is that it becomes displayed late in life so that an individual with the gene and who will certainly display the character reproduces his kind before he is made aware of the danger. In such a case only the careful study of the pedigree of the families concerned can provide information concerning the possibility that a given individual possesses the gene. The most likely constitution of the parents is one Dd, a heterozygote with the dominant gene in the simplex state and the other dd, without this gene. When this is so the risk that a child of the marriage has received the gene for Huntington's chorea is 1 in 2.

This property of dominance is variable in respect of its 'strength'. Sometimes the character based upon an autosomal dominant gene is not displayed even though its gene is known to be in the genotype of the individual concerned since it is transmitted to the progeny who display the character. The character 'skips a generation'. The ability of a gene to gain expression, its penetrance, is affected by the action of other genes in the same genotype with the result that when a gene is a member of certain gene associations it can gain expression, complete or partial, whereas in others it fails to do so.

Quite frequently it is found that a child displaying an autosomal dominant character has parents both of whom exhibit the corresponding recessive character. Furthermore, when the pedigree is examined it is found that in it there is no trace of the dominant character. Penetrance is not involved in such a case; it is an example of 'fresh' or 'recurrent' mutation, of mutation that has occurred in the germ-track of one of the parents of the affected child. It is unlikely that the sibs—brothers and sisters—of such a child will also display the character concerned but the children of the one with the fresh mutation will run the risk of doing so, the chances being the usual 1 in 2.

Some dominant genes yield characterisations that are incompatible with continued existence, are lethal in their effects. When this is so the gene in question cannot be transmitted from one generation to the next and new examples of the characterisation must always arise *de novo* as fresh mutations. In epiloia, for example, it has been found that not more than 50 per cent of the affected children have affected relatives so that if the frequency of this condition in a population is to remain more or less constant fresh mutation must account for many instances. Other genes lower the reproductive fitness of their possessors and so an equilibrium becomes established, the rate at which fresh mutations are fed into a population is balanced by the rate at which elimination of the gene from the population through lowered reproductive fitness occurs.

Examples of frequencies of autosomal dominant abnormal conditions in the population

Retinitis pigmentosa (all forms)	1 in 5,000
Achondroplasia	1 in 10,000
Retinoblastoma	1 in 33,000
Epiloia (irregular)	1 in 50,000
Osteogenesis imperfecta (irregular)	1 in 50,000

In marked contrast with the autosomal dominant gene and character are the autosomal recessive gene and character. The recessive gene can find expression only when present in duplicate, dd, when it has been received from both of the parents. In the heterozygous state it can remain hidden and unsuspected for many generations and so find itself incorporated in a wide variety of genotypes.

Any individual who displays an autosomal recessive character is necessarily homozygous for the gene that corresponds to it, dd. In a pedigree the character tends to be displayed by more than one member of a sibship and in no other relative. In such a pedigree all those who display the alternative dominant character are either homozygous for the alternative dominant gene or else heterozygotes, being carriers of the recessive gene, Dd. The probability of a brother or sister of the individual displaying the recessive character and exhibiting the alternative dominant character, being a heterozygote, Dd, is 2 in 3 and of being a homozygous dominant, DD, is 1 in 3.

Dd		×		Dd	Parents, both heterozygotes
D	d	:	D	d	Gametes
DD	Dd		Dd	dd	Offspring
Homozygous dominants	Heterozygous dominants			Recessive	
1	2			1	
3					

When the recessive character takes the form of serious defect or derangement the identification of the carrier can be a matter of considerable importance. As yet only in a few diseases can the heterozygotes be identified. The carrier in phenylketonuria can be detected by means of the phenylalanine test. In nephrogenic diabetes insipidus the carrier female is unable to produce a normally concentrated urine. The identification of the heterozygote is simple when the single dose of the recessive gene yields one characterisation and the double dose gives another, that is to say when the heterozygote has a character all its own, when dominance is not complete. Examples of this are shown in Table 1.

TABLE 1

Character of heterozygous recessive (Dd)	Character of homozygous recessive (dd)
Fibrinogenopenia	Afibrinogenaemia
Small eyeballs	Anophthalmia
Pes cavus and absent tendon reflexes	Friedreich's ataxia
Obesity, skeletal abnormalities	Laurence–Moon–Biedl syndrome
Mild degree of myopia	Severe degree of myopia
Sickle-cell trait	Sickle-cell anaemia
Thalassaemia minor	Thalassaemia major (Cooley's anaemia)
Hypercholesterolaemia	Xanthomatosis
Excessive freckling	Xeroderma pigmentosum

The sickle-cell trait and anaemia and thalassaemia minor and major are examples of balanced polymorphism. The sickle-cell trait is very common in Africa north of the Zambesi, reaching a frequency of about 25 per cent in some areas. This means that some 40 per cent of the population of the area are heterozygotes, carriers of the gene and this, in turn, means that it is to be expected that some 6 to 7 per cent of all the children are suffering from sickle-cell anaemia.

In the countries that border the Mediterranean the gene involved in thalassaemia is very common, reaching a frequency of about 10 per cent in the region of Ferrara in Italy. This means that about 1 in every 5 of the population is a carrier so that 1 in every 100 children born can be expected to suffer from Cooley's anaemia, having received the gene from both of its parents.

The reason why these genes, which in the double dose are responsible for so much suffering and death, are so common is because they endow the possessor of the gene in the single dose with considerable powers of resistance to tertian malaria. This is certainly true of the sickle-cell gene and most probably true also for the thalassaemia gene. The advantage which the heterozygote enjoys balances the loss by death of the less frequent homozygotes. The question arises as to whether or not the gene for fibrocystic disease of the pancreas, which in the double dose is so commonly the cause of the death of a child, offers, in certain environments, similar advantage of some kind when in the single dose. The disease is relatively common in the population with a frequency of 1 in 1,600–2,000.

TABLE 2

Examples of frequencies of autosomal recessive abnormal conditions in the population

Deafmutism	1 in 3,000
Exomphalos	1 in 3,200
Albinism	1 in 10,000–20,000
Microcephaly	1 in 25,000–50,000
Phenylketonuria	1 in 25,000–40,000
Amaurotic family idiocy (juvenile form)	1 in 40,000
Fructosuria	1 in 130,000
Pseudoxanthoma elasticum	1 in 160,000
Amytonia congenita	1 in 225,000
Amaurotic family idiocy (infantile form)	1 in 250,000 (mostly among Jews)
Alkaptonuria	1 in 1,000,000

The carriers of an autosomal recessive gene are far more common in the population than those who have the gene in duplicate and display the character. For example, if 1 in every 2,000 of the population has the gene for fibrocystic disease of the pancreas in the double dose, 1 in every 20 to 25 will be a carrier. If 1 in every 25,000 is homozygous for the gene for phenylketonuria then 1 in every 80 will be heterozygous for this gene. If 1 in every 40,000 of the population suffers from amaurotic family idiocy then 1 in every 100·5 can be expected to possess this gene in the single dose.

Alkaptonuria, phenylketonuria and fructosuria, mentioned above, are examples of 'inborn errors of metabolism' and belong to the field of biochemical genetics. They are conditions, genetically caused, that indicate in the clearest possible fashion the nature of gene action and of normality. They show that healthiness and normality are determined in part by the presence and action of a number of enzymes. Mutant genes in their action cause certain of these enzymes to be absent. For example, in the normal individual phenylalanine, an amino-acid component of protein-containing foodstuffs, is broken down in a series of steps, each one of which requires the action of a particular enzyme. The steps are phenylalanine, tyrosine, p-hydroxyphenylpyruvic acid, homogentisic acid, maleylacetoacetic acid, fumarylacetoacetic acid, fumaric acid and acetoacetic acid. The end-products, fumaric acid and acetoacetic acid, are both metabolised to carbon dioxide and water. In phenylketonuria this process cannot proceed further than phenylpyruvic acid, in alkaptonuria further than homogentisic acid because of the lack of the appropriate enzymes and so phenylpyruvic acid and homogentisic acid accumulate in the body to be excreted in the urine. Other conditions which are due to the absence of a specific enzyme and therefore to the action of an autosomal recessive gene which is responsible for this absence are shown in Table 3.

TABLE 3

The condition	The missing enzyme
Acatalasaemia	Catalase
Albinism	Tyrosinase
Congenital hyperbilirubinaemia	Glucuronyl transferase
Cystathioninuria	Cystathioninine cleavage enzyme
Galactosaemia	Galactose-phosphate uridyl transferase
Glycogen storage disease (*a*)	Glucose-phosphatase
(*b*)	Amylo-1:6 glucosidase
(*c*)	Amylo-1:4-1:6 trans-glucosidase
Goitrous cretinism (a form of)	Dehalogenase
Hypophosphatasia	Alkaline phosphatase
Methaemoglobinaemia (a form of)	Diaphorase 1 (methaemoglobin reductase)
Suxamethonium sensitivity	Serum Cholinesterase (pseudo-cholinesterase)

The gene which in the double dose is the cause of a very low level of pseudo-cholinesterase is of special interest for the reason that its presence is revealed only when its possessor is given the drug suxamethonium as a muscle relaxant in anaesthesia when a fatal apnoea is liable to develop. It is a very common gene, about 1 in every 2,000 of the population being homozygous for it. It is manifestly of importance that such homozygotes should be identified before an operation. It is reasonable to assume that this gene existed before suxamethonium was first used but as yet nothing is known of its actions other than this most peculiar one. It is probable that this condition is not based upon a single recessive gene but is polygenic, possibly a multiple allelomorphic series is involved.

In the case of a recessive condition it is the birth of an abnormal child that usually calls attention to the existence of an undesirable gene in the pedigree. This being so it is the possibility that a subsequent child may display the same undesirable character that engages the attention of the geneticist. The probability that a second child, born to parents themselves phenotypically normal who have already produced an affected child will likewise be affected is 1 in 4. If when born a second child is phenotypically normal the probability that it is homozygous for the alternative dominant gene, DD, is 1 in 3 and that of its being a heterozygote, Dd, 2 in 3. If one parent displays a recessive character, being dd, and the other is phenotypically normal, being either DD or Dd, the discussion of probabilities requires a knowledge of the frequency of carriers of the recessive gene in the general population. If for example, the frequency of carriers is 1 in 70 the probability that an affected individual, dd, will marry a carrier, Dd, is 1 in 70. The probability that an affected individual, dd, mated with a phenotypically normal person will have an affected child is 1 in 70. If a phenotypically normal sib of an affected individual mates with a phenotypically normal and unrelated person the probability of this mating producing an affected child is the probability of the sib being a heterozygote Dd, (2 in 3) times the probability of the spouse also being a carrier, Dd (1 in 70) times the probability of the child getting the recessive allele from each of its parents (1 in 4):

$$\frac{2}{3} \times \frac{1}{70} \times \frac{1}{4} = \frac{1}{420} \text{ or 1 in 420.}$$

The probability of the first child of two heterozygotes, (Dd × Dd) being affected, dd, is 1 in 4 as is also the probability of the second child of the same marriage being affected. But the probability of both the first and the second children being affected is 1 in 16, the product of the two independent chances.

It has been estimated that every individual in the population carries between three and eight harmful autosomal recessive genes in the single dose. But because such genes are so very numerous it is most unlikely that any two unrelated individuals will have the same set and most marriages are of unrelated persons. The more closely related two people are the more likely is it that they will possess the same harmful recessive genes in the single dose. First cousins share a common ancestor; for this reason they are more likely to produce a child homozygous for some harmful gene than are two unrelated people. In Britain about 3 per cent of all marriages are between first cousins; in Japan the percentage is 15. It has been found that the risk of dying in infancy or of suffering from some serious congenital defect is very much greater among the offspring of first cousin marriages than among infants and children generally. About 15 per cent of those with the juvenile form of amaurotic family idiocy have first cousin parents as do also about 25 per cent of those with the infantile form of this disease, 10 per cent of those with Friedreich's ataxia and 13 per cent of those with muscular atrophy (Werdnig–Hoffman).

Sex-linkage

Many hundreds of mutant characters are known to have their genes resident in the autosomes and more than fifty are sex-linked, having their genes in the differential segment of the X-chromosome. The mode of inheritance of these must inevitably be different from that of an autosomal character for the reason that in respect of them the male is constitutionally heterozygous or hemizygous and heterogametic, producing two kinds of spermatozoa in respect of the sex-chromosomes. The female can be either homo- or hetero-zygous for a particular gene and is homogametic, producing but one kind of ovum, X-bearing.

Male XY × XX Female
X Y : X Gametes
XX XY Offspring

The single X of the father passes to his daughter who must receive an X from each of her parents. The Y of the father passes to his son whose X comes from his mother. A recessive gene in the X of a male has no counterpart in the Y and so can gain expression in the single dose. A recessive gene on one of the Xs of the female can be associated with its dominant allele in the other so that she can be a carrier. If she is to display a recessive character she must possess the gene in the double dose. Examples of sex-linked recessive characters are classical haemophilia, Christmas disease, the severe form of Duchenne-type muscular dystrophy, nephrogenic diabetes insipidus, primaquine sensitivity and possibly testicular feminization. (Let the underlining of an X indicate that in it there is a recessive gene.) Possible matings:

1. Affected ♂ $\underline{X}Y$ × affected ♀ $\underline{X}\underline{X}$ = affected sons $\underline{X}Y$ and daughters $\underline{X}\underline{X}$
2. Affected ♂ $\underline{X}Y$ × carrier ♀ $X\underline{X}$ = normal sons XY, affected sons $\underline{X}Y$, carrier daughters $X\underline{X}$ and affected daughters $\underline{X}\underline{X}$
3. Affected ♂ $\underline{X}Y$ × normal ♀ XX = normal sons XY and carrier daughters $X\underline{X}$
4. Normal ♂ XY × affected ♀ $\underline{X}\underline{X}$ = affected sons $\underline{X}Y$ and carrier daughters $X\underline{X}$
5. Normal ♂ XY × carrier ♀ $X\underline{X}$ = normal sons XY, affected sons $\underline{X}Y$, normal daughters XX, carrier daughters $X\underline{X}$

The last of these matings is the commonest source of an individual displaying a sex-linked recessive character, a male. If the mother of an affected son has another male relative who is affected then she is a carrier and the risk of further sons being affected and of daughters being carriers is 1 in 2. But if she is an instance of fresh mutation (gametic) she is not likely to have further affected sons and carrier daughters.

Primaquine sensitivity is a most peculiar character. About 14 per cent of American negro males have it as do about 2 per cent of the females. It is exceedingly common among the Yemenite Jews in Israel, about 60 per cent. Its essential feature is a deficiency of glucose 6-phosphate dehydrogenase. Ordinarily its possessor is unaware of it until he eats fava beans. The administration of primaquine, as an anti-malarial, phenacetin, the sulphonamides and a number of other drugs produces a severe haemolytic anaemia.

The characters based upon a gene in the differential segment of the X have a higher frequency in the male for the reason that the male needs but one such gene to display the character whereas the female needs two, one from each parent. Quite a number of autosomal characters also have a higher frequency in the male, or gain a fuller degree of expression. Stature is partly genetically determined and the genes that underlie it can be possessed equally by male and female. Yet females, on the average, are shorter than males. The Laurence–Moon–Biedl syndrome is about twice as common in the male. The penetrance of a gene is affected by the sex of the individual. Some genes gain expression in one sex far more frequently than in the other. The explanation for this is that the genes concerned are functioning in two very different internal physiological environments, maleness and femaleness respectively. It is the difference between maleness and femaleness that lies at the root of the generalisation, to which there are very few exceptions (whooping-cough, anencephaly) that any defect or derangement that affects both sexes affects the male more frequently and more profoundly than the female. When all the causes of death are added together, at all ages relatively more males than females are removed from the population by death in a country such as Britain. The male is less viable, more fragile than the female of the species.

The transmission of a dominant sex-linked character with its gene in the differential segment of the X is quite different from that of a sex-linked recessive. Vitamin D-resistant rickets is an example. An affected male transmits the gene to his daughters but not to his sons; an affected female (heterozygous) transmits it to both sons and daughters.

1. Affected $\underline{X}Y$ × normal XX = affected daughters $\underline{X}X$; normal sons XY
2. Normal XY × affected $\underline{X}X$ = affected sons $\underline{X}Y$; affected daughters $\underline{X}X$
   normal sons XY; normal daughters XX

Characters the genes for which are resident in the Y-chromosome, in the absence of crossing-over between the X and Y, will be restricted to the male line. (During gametogenesis the two members of a pair of homologous chromosomes come to lie closely applied side by side, become intertwined and then separate. During this process it happens occasionally that the two chromosomes stick together and break where they stick and then the pieces reunite, a piece of one of them joining up with the stump of the other so that there is an interchange of equivalent portions of chromosomal material between the two. So long as the two exchanged pieces carry the same alleles in their loci this crossing-over has no sequel since that which is lost is regained. But if the two pieces differ in respect of the alleles they carry, dominants in one, recessives in the other, the exchange is followed by observable changes in linkage relationships.)

Polygenic and Partly Genetic Characters

Most characters are of this kind. Stature, body build, general intelligence, disease resistance and susceptibility, major malformations of the central nervous system, congenital pyloric stenosis, spina bifida, Hirschsprung's disease, mental defect, schizophrenia, rheumatic fever and diabetes mellitus are examples of such. In their causation there is a genetic component, consisting usually of several genes the effects of which are additive, and an environmental component consisting of some particular factor or factors that in their action permit or encourage gene action. Mendelian ratios cannot be fitted to the mode of inheritance of such characters. But from twin studies and from large scale investigations which include large numbers of pedigrees it is possible to demonstrate that there is a genetic component in causation and to compute the probability that relatives of an affected individual will display the same character. For example, the risk of a son of a mother who had congenital pyloric stenosis developing the same condition is 1 in 5. The risk of a sib of a child who has Hirschsprung's disease developing the same disease is about 1 in 8. If one of the parents is schizophrenic the risk that a child will develop the same condition is about 1 in 10, this risk being modified by a good early environment. When a couple have produced a child with spina bifida the risk that a subsequent sib will also have the same defect is about 1 in 25. When a couple have had two affected children the risk for a subsequent sib is increased to about 1 in 7.

The Same Character caused by Different Genes

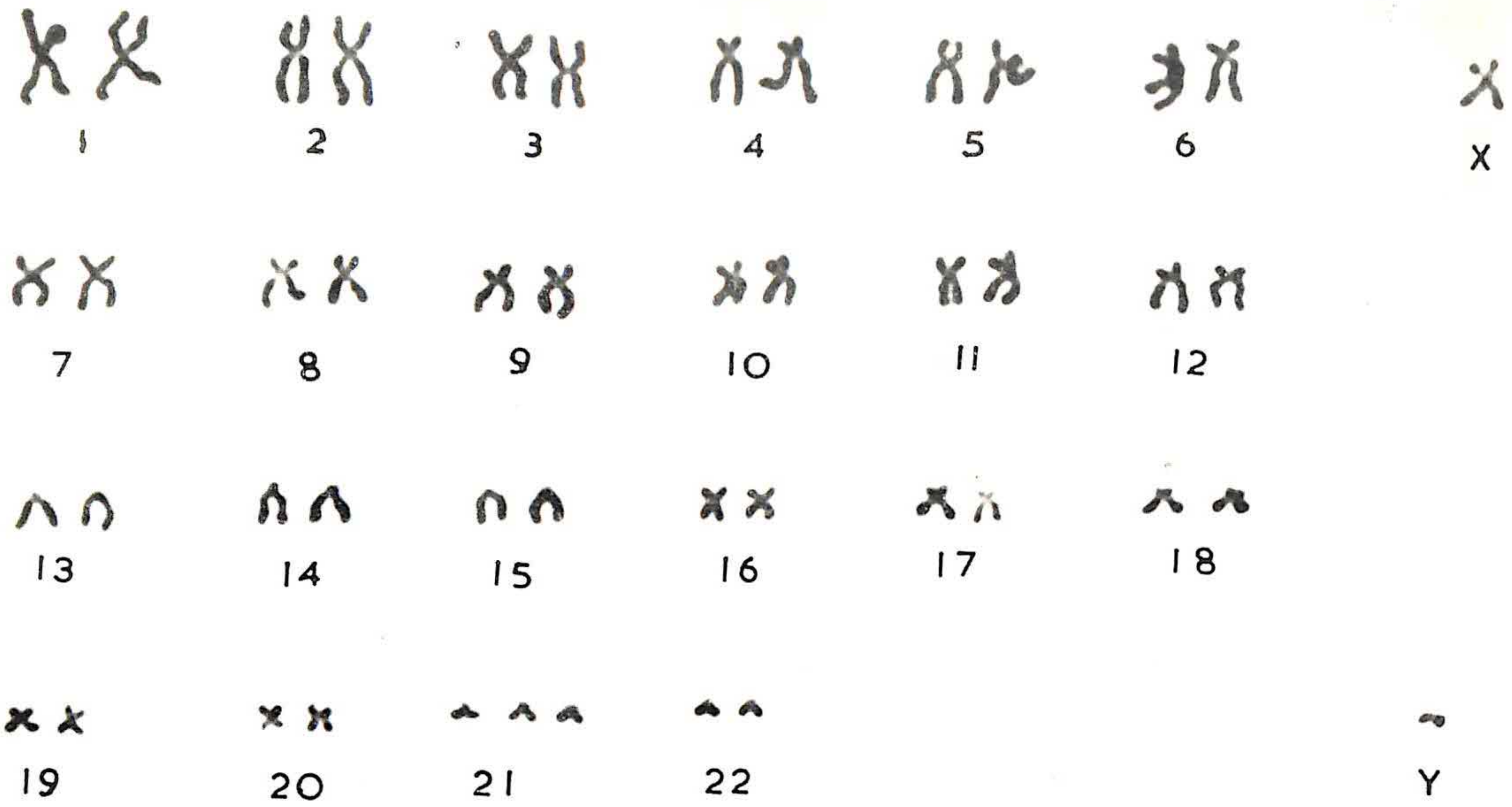
Of retinitis pigmentosa there are three distinct genetic forms, a typical autosomal dominant, an autosomal recessive and a sex-linked recessive. That this is so is not surprising for hereditary blindness is not always the outcome of the same developmental event; it can be due to abnormality of the retina, of the lens or of the whole optical apparatus. When the abnormality is always the same, as in retinitis pigmentosa, and yet shows differences in respect of its genetic basis the explanation would seem to be that one set of developmental processes is involved, that several genes are concerned and that mutation of any one of them disturbs these processes to yield the same end-result. If genes act by guiding and deflecting developmental processes and if to the number of ways in which such processes can be altered there is a limit, it is not surprising to find that more than one gene can yield the same character.

Mimicry

Nor is it surprising to find that the impress of environmental factors upon these developmental processes at critical points during their course can produce results that are exact simulations of hereditary characters, mimics or phenocopies. Such an acquisition can in its appearance be indistinguishable from an inherited character. It is never safe to assume that many forms of defect and derangement in given individuals are genetically based merely for the reason that in other individuals they have been shown to be inherited. Deafmutism, for example, in about 50 per cent of instances is indubitably genetic in origin, in the other 50 per cent it is the sequel of meningitis, rubella and other diseases and is an acquisition and a phenocopy. Here is the reason why the mating deafmute × deafmute can give such divergent results; the acquired deafmute has the dominant allele of the autosomal recessive gene for deafmutism and the mating genetic deafmute × acquired deafmute will give all phenotypically normal offspring who are carriers of the gene.

Maldistribution of Chromosomal Material as a Cause of Abnormality in Characterisation

After exposure to colchicine, hypotonic citrate solution, fixation, staining and squashing the chromosome complex is photographed, greatly enlarged. The individual chromosomes are then cut out from the photograph and arranged in pairs to form a karyotype. They fall roughly into seven size-groups (1–3; 4 and 5; 6–12; 13–15; 16–18; 19–20; 21 and 22). The X is of the same size as 6–12; the Y of the same size as 21 and 22. It is a relatively simple matter to assign a particular chromosome to its size-group but far from easy to place it in its proper place within the group. In the ideogram (a diagrammatic representation of a karyotype) any deviation from the normal in respect of chromosome number or structure can be recognised.



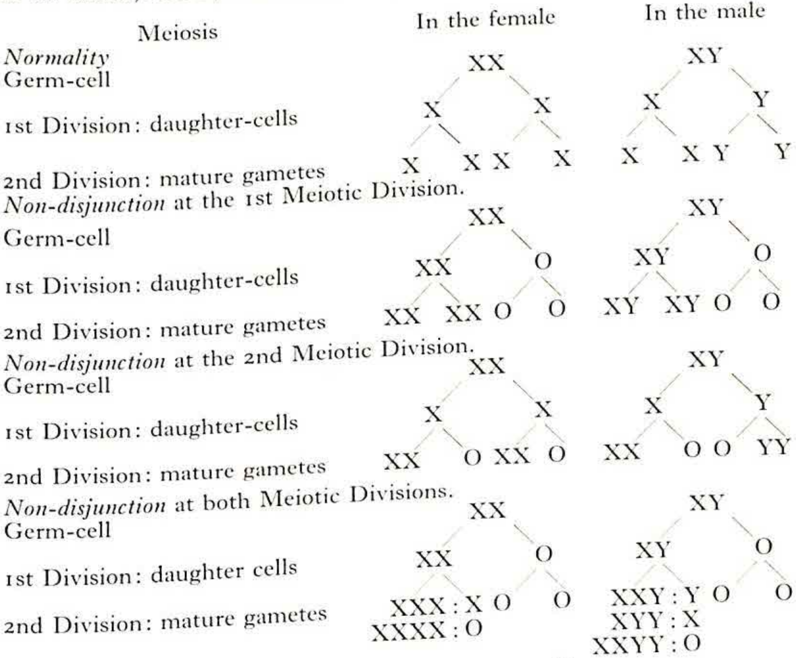
(*Courtesy of Dr. P. Jacobs*).

FIG. 1. Karyotype of a Human Male with Mongolism. Trisomy for Chromosome 21.

Abnormality in respect of the number of X-chromosomes in the chromosome complex can be detected by the use of the sex-chromatin test. Lying just beneath the nuclear membrane of somatic cells from the body of a female there is to be found a Feulgen-positive particle. This sex-chromatin particle is absent from the cells from a male. The number of particles is one less than the number of X-chromosomes in the karyotype. The sexes are to be distinguished also by means of the drumstick test. The lobed nuclei of a small percentage of polymorph leucocytes in the female have projections, drumsticks; these are absent from similar cells from the male. These drumsticks, like the sex-chromatin particles, are composed of X-chromosome material. Since it is the rule for an XX zygote to follow that developmental path that ends in a female characterisation and for an XY zygote to become a male, these tests can be used with advantage to identify the sex of an individual. The sex-chromatin differences are also found in the epithelial cells in buccal smears and in the debris in the liquor amnii. The terms chromatin-positive and chromatin-negative are used to indicate the presence and absence respectively of these particles.

Aneuploidy resulting from Non-disjunction of the Sex-chromosomes

Non-disjunction of the X-chromosomes can occur either during meiosis or during mitosis. During meiosis it can occur either at the first or the second division of the oocyte or spermatocyte. If it occurs at the first or at the second division of the oocyte the mature ova will come to have either two Xs or else none at all, but if it occurs at both of these divisions there can be mature ova with three or four Xs. In the male, non-disjunction at the first division yields XY and O spermatozoa; at the second XX, YY and O spermatozoa and at both of these divisions, XXY, XXYY, XYY, X, Y and O spermatozoa.

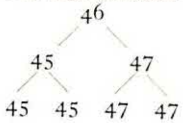

Meiosis
In the female
In the male
Normality
Germ-cell
XX
XY
1st Division: daughter-cells
X X
X Y
2nd Division: mature gametes
X X X X
X X Y Y
Non-disjunction at the 1st Meiotic Division.
Germ-cell
XX
XY
1st Division: daughter-cells
XX O
XY O
2nd Division: mature gametes
XX XX O O
XY XY O O
Non-disjunction at the 2nd Meiotic Division.
Germ-cell
XX
XY
1st Division: daughter-cells
X X
X Y
2nd Division: mature gametes
XX O XX O
XX O O YY
Non-disjunction at both Meiotic Divisions.
Germ-cell
XX
XY
1st Division: daughter cells
XX O
XY O
2nd Division: mature gametes
XXX : X O O
XXXX : O
XXY : Y O O
XYY : X
XXYY : O

(O = no sex-chromosomes at all).

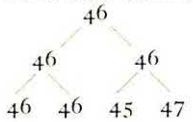
When non-disjunction of the Xs has occurred both normal and non-disjunctional gametes are available for participation in fertilisation and it becomes possible for other and even more unusual karyotypes to appear.

Meiotic non-disjunction yields an individual composed of cells all with the same abnormal number of chromosomes. Mitotic non-disjunction of the X-chromosomes occurring at the first cleavage division of the fertilised ovum yields two kinds of cells, one with one chromosome fewer than the normal number and the other with one chromosome more than this. If it occurs at a later mitotic division of the descendants of the fertilised ovum it will give rise to three cell-lines, one with the normal number, 46, one with one chromosome fewer than this, 45, and one with one chromosome more, 47. Individuals whose bodies are composed of cells derived from two or more cell-lines are mosaics.

Non-disjunction at the first cleavage division



Non-disjunction at a cleavage division later than this



Non-disjunction is not restricted to the X-chromosomes, it can happen to any of the autosomes, to autosome number 21, for example, so that a gamete can possess two 21s instead of the normal one. Such a gamete, fusing with another with the normal single number 21 will give rise to a zygote that is trisomic for 21.

Of the many possible sex-chromosome aberrations the following have been identified (Table 4):

TABLE 4

Chromosome complex	Total number	Chromatin-positive or negative	Phenotype	
$2n-1$	45 (44A.XO)	− or +	Female.	Turner's syndrome
$2n+1$	47 (44A.XXY)	+ or −	Male.	Klinefelter's syndrome
$2n+1$	47 (44A.XYY)	−	Male.	
$2n+1$	47 (44A.XXX)	+ +	Female.	Triple-X, super-metafemale
$2n+2$	48 (44A.XXXY)	+ +	Male.	Klinefelter's syndrome
$2n+2$	48 (44A.XXYY)	+	Male.	Klinefelter's syndrome
$2n+2$	48 (44A.XXXX)	+ + +	Female.	
$2n+3$	49 (44A.XXXXY)	+ + +	Male.	Klinefelter's syndrome

n = the haploid number of chromosomes, $2n$, twice this number (46).
A = autosomes.
XO = the symbol used to indicate the presence of only one X-chromosome.

The following sex-chromosome mosaics have also been encountered:

Two cell-lines				Three cell-lines
XO/XX	XO/XY	XO/XXX	XO/XYY	XO/XX/XXX
XX/XY	XX/XXX	XX/XXY	XXXY/XXXXY	XX/XXY/XXYYY

In most instances of mosaicism the cause is the elimination of a sex-chromosome at mitotic anaphase; in others it is non-disjunction of the sex-chromosomes. The XO/XY mosaic can be what is wrongly termed a true hermaphrodite, an individual with both testicular and ovarian tissues. Since hermaphroditism is a normal condition in many species in which both kinds of gonadic tissue are functional and since the presence of both testicular and ovarian tissues in one and the same individual is abnormal in man, neither of them being completely functional, it is reasonable to regard this condition in man as a high grade of intersexuality and not as hermaphroditism. There is strong reason for thinking that for the development of testicular tissues the presence of a Y-chromosome is essential. Mosaics in whom there is a cell-line with the XO sex-chromosome constitution commonly display the stigmata of Turner's syndrome. Those with an XXY cell-line commonly develop the signs of Klinefelter's syndrome.

Since chromosome elimination and non-disjunction are accidents that cannot be foreseen, to prevent their occurrence remains impossible. Non-disjunction of chromosome number 21 leading to the production of a zygote trisomic for this chromosome is the root cause of Down's syndrome, mongolism, the second commonest genetically determined disorder in north-western Europe. Since such disjunction is an accident the risk that a second affected child will be born is very small indeed. But a few instances of this condition (in those born at younger maternal ages) are the direct consequence of a chromosomal anomaly in one of the parents which takes the form of a translocation, an extra number 21 chromosome being attached to a number 15. A mother with such a translocation runs about a one in three risk of having an affected child at each pregnancy. It is important, therefore, to determine, by examination of the karyotype, whether or not a child with Down's syndrome is an instance of translocation and, if it is, to examine the karyotypes of the two parents. The risk of a second child being affected can then be assessed.

In Down's syndrome the age of the mother, but not that of the father, is important. The percentage of children who are affected born to mothers over the age of 40 years is about one. This compares with an overall incidence of the condition of about 1·6 per 1,000.

Trisomy of other autosomes produces other syndromes, *e.g.* Edward's syndrome (a chromosome of the 17 to 18 group) and Patau's syndrome (a chromosome of the 13 to 15 group); the affected children are grossly abnormal and usually do not survive. The cause of yet another syndrome in which the affected infant is severely retarded in its physical and mental development and which has been called the *cri du chat* syndrome, for the reason that the child has a characteristically peculiar weak mewing cry, is deletion of the shorter arm of one of the chromosomes numbered 5.

The Frequency and Relative Importance of Defects and Derangements Wholly or Partially Genetically Determined

In a report of the United Nations Committee on the Effects of Atomic Radiation, 1962, it was estimated that about 6 per cent of all liveborn children have some form of defect or derangement of genetic origin and that the abnormalities could be classified by cause as follows: 4 per cent due to the action of polygenes, most of them as yet unidentified; 1 per cent due to specific major genes; and 1 per cent due to some form of chromosome aberration.

At the beginning of the present century the infant mortality-rate in Britain was about 140 per 1,000; it is now around 20 per 1,000. This very remarkable fall in so short a time has been due to the ever-tightening control that has been gained over the environmental agents, living and non-living, which at the beginning of the century were responsible for the bulk of infant mortality and especially over the pathogenic micro-organisms that attacked the respiratory and alimentary tracts of the infant. But infant deaths from two causes, birth injuries and congenital malformations, are not less numerous now than they were sixty years ago. In the causation of congenital malformations genetic factors play an important role. Because the death-rate from causes present in the environment of the individual has fallen progressively while that due to congenital malformations has remained more or less stationary at about 5 to 6 per 1,000, it follows that the relative importance of congenital malformations as a cause of infant death has progressively enlarged. At the beginning of the century about 1 death in every 32 was due to this cause; now the figure is nearly 1 in 4. Between 1922 and 1950 the prevalence of blindness among school children was halved; in 1922, 37 per cent of the cases were attributed to genetic causes; by 1950 this percentage had risen to 68. It is because the relative importance of genetic and partly genetic (genetico-environmental) anomalies increases as morbidity and mortality due to all causes fall that during recent years the subject of medical genetics has undergone so rapid and so great a growth.

Since the discovery of the sex-differences in respect of the chromatin-particle and the development of greatly improved cytological techniques for the study of the chromosome complex several large-scale investigations have been undertaken to discover the incidence of sex-chromosome aberrations in different groups of individuals, the newly-born, the still-born and aborted and the mentally defective. There has been a large measure of agreement among the results obtained so that it will suffice to mention just one or two. In an Edinburgh study (Maclean *et al.*, 1964) of 20,725 new-born babies, 10,725 phenotypic males and 10,000 phenotypic females, it was found that 21 of the phenotypic males were chromatin-positive (1.96 per 1,000); 4 of the phenotypic females were chromatin-negative (0.4 per 1,000); and 12 of the phenotypic females had two chromatin particles (1.2 per 1,000). The karyotypes of 18 males and 13 females were examined cytologically and showed that of the phenotypic males, 12 had the XXY sex-chromatin constitution, 1 the XXYY sex-chromatin constitution, and 5 were XY/XXY mosaics. Of the phenotypic females, 9 had the XXX sex-chromatin constitution, 3 the XO sex-chromatin constitution, and 1 was a mosaic.

In a study of 397 babies dying in the perinatal period (212 phenotypic males and 185 phenotypic females) there were found 4 phenotypic males who were chromatin-positive and 1 phenotypic female who was chromatin-negative (and XO).

Among abortuses a high frequency of chromosome aberrations has been found and it has been noted that the XO sex-chromosome constitution seems to be associated with a lowered viability of the embryo (Carr, 1963). Possibly this is due to the very frequent occurence of congenital cardiac abnormality in Turner's syndrome.

In a study of 4,514 mental defectives (2,607 phenotypic males, 1,907 females) it was found that 28 of the phenotypic males were chromatin-positive, 23 with a single particle, 4 with two and 1 with three (10·7 per 1,000), 8 of the phenotypic females had two chromatin particles (4·2 per 1,000) and 1 was chromatin-negative (Maclean *et al.*, 1962). From studies such as this there emerges the strong suggestion that there is a significant association between an increased amount of X-chromatin material and major mental deficiency in both phenotypic males and females. Among new-born babies generally the incidence of the XXX constitution was found to be only 0.8 per 1,000, whereas among female individuals with major forms of mental deficiency it was found to be 4.5 per 1,000.

Intersexuality: Genetic Aspects

The sex of the infant is identified by the design of the external genitalia, penis and scrotum in the male, vulva and vagina in the female. Exceptionally, this difference is not clear-cut, the genitalia are neither completely male nor completely female but intermediate between the two, and it is difficult to decide what the sex of the infant is. Yet such a decision has to be made for much depends upon it. Male is to be distinguished from female by differences in their sexual characterisation which, for purposes of discussion, can be broken down into (i) the sex-chromosome constitution; (ii) the gonads; (iii) the accessory sexual apparatus; (iv) the external genitalia and (v) (in the mature) the secondary sexual or epigamic characters. Normality in respect of this characterisation is based upon congruence of all these items, each of them being male-type or, alternatively, all of them being female-type. If among them there is incongruence intersexuality results, for example, the association of a male-type sex-chromosome constitution, as revealed by the nuclear sex-chromatin test, the polymorph leucocyte drumstick test or by the karyotype, with female-type external genitalia or with a mixture of male-type and female-type structures of the accessory sexual apparatus is regarded as a form of intersexuality. It has been estimated that 2 or 3 per 1,000 individuals display one or other form of this condition.

The basic cause of the sex-dimorphism that distinguishes male from female is the difference between two distinct genetic constitutions. In these genotypes are many genes concerned with the determination of sex, some of them male-determining, others female-determining. The latter are congregated in the X-chromosome, the former in the Y and in the autosomes. This being so the two genotypes can be represented as 1X:1Y.2A and 2X:2A respectively, 2A representing the two sets of autosomes, 44 altogether and X and Y the sex-chromosomes. In the XY zygote the male-determining genes are in effective excess of the female-determining for the reasons that there is only one X and in the Y are male-determining genes. In the XX zygote, on the other hand, with two Xs and no Y, the female-determining genes are in effective excess. The quantitative difference between these two kinds of sex-determining genes decides which kind of internal physiological environment within the embryo shall become established, one of maleness or one of femaleness.

As the embryo evolves the precursors of the gonads are laid down. To begin with they are quite indifferent sexually and come to consist of two distinct regions, a cortex and a medulla, the former being the forerunner of the ovary, the latter with a specific potentiality for becoming a testis. In the male-type environment the growth and differentiation of the medulla are encouraged and those of the cortex inhibited; in the female-type internal environment the differentiation of the cortex into an ovary is promoted.

When the gonads have become differentiated and endocrinologically functional they assume control of the differentiation of the rest of the sex and reproductive equipment. A zygote becomes equipped with a male-type characterisation because it came to possess testes but it came to possess testes because it was, in the beginning, an XY zygote in which the male-determining genes were paramount. It is the rule for an XY zygote to develop into a phenotypic male and for an XX zygote to become equipped with a sexual characterisation that is typically female-type.

It follows therefore that abnormality of the sexual characterisation can result from a disturbance of the balance between the male-determining and the female-determining genes in the 1X : 1Y . 2A and the 2X : 2A genotypes by gene mutation, by aneuploidy or by delay in the elaboration of those forces that control the differentiation of the embryonic gonads or affect the endocrinological functioning of the differentiated gonads.

In agonadism the gonads never become differentiated and so there is no differentiation of the rest of the sex and reproductive equipment. Typically the agonadic individual is chromatin-negative. It has been suggested that the ultimate cause of this condition will be found to be aneuploidy involving the sex-chromosomes.

In testicular feminisation the affected individual is chromatin-negative and XY in sex-chromosome constitution but the general sexual characterisation is of the female pattern. The external genitalia are female-type though the vagina usually ends blindly and the uterus remains infantile in proportions. The gonads are testes and may be located in the labia majora, in the inguinal canals or within the abdominal cavity. The phallus may include a urethra of the male pattern. This condition is genetically caused, the gene responsible for it being either a sex-linked recessive or an autosomal dominant.

There are two forms of pseudo-hermaphroditism. The male pseudo-hermaphrodite is chromatin-negative and has two testes. But the remainder of the sex equipment shows a degree of feminisation. The female pseudo-hermaphrodite is chromatin-positive and has two ovaries but the rest of the sex equipment shows a degree of masculinisation. Among the several causes of these conditions genetic factors have been included.

In 'true hermaphroditism' or ambisexuality there is a wide range of variation in the sexual phenotype from male-type to female-type and an equally wide range in the structure of the external genitalia. The majority of cases are chromatin-positive and the sex-chromosome constitution is usually XX, though XY and XO/XY instances have been recorded. The essential feature of this condition is the presence of both testicular and ovarian tissues either separately or combined in an ovo-testis. A uterus, vagina and, in most cases, a prostate are present. Usually a vas deferens runs to the testicular material and a Fallopian tube to the ovarian. Spermatogenesis is incomplete but ova may mature in the ovarian tissues. If not infecund the 'true hermaphrodite' is certainly infertile in mating. The immediate cause of the condition is a faulty differentiation of the gonads to yield both kinds of gonadic tissues. Many hold the view that the presence of testicular tissues is an indication that there is a Y-chromosome in the sex-chromosome constitution, the individual being a mosaic, *e.g.* XX/XXY, the Y being present in those cells from which the testicular material arose. Others are of the opinion that the explanation may be that the paternal X had, by translocation or by crossing-over with the Y, come to be the vehicle of genes that are normally Y-borne.

From time to time it is discovered that a child who was assumed to be a female because of the design of the external genitalia and who has been brought up as a girl is in fact an intersex. Cryptorchid testes are found in the labia majora or in the inguinal canal and the clitoris has become abnormally large. A decision of the greatest importance to the individual concerned has to be made. Shall the child's characterisation be so modified, by surgery and hormone therapy, that it approximates as closely as possible to the normal female-type or shall it be made as typically male as possible? No general rule can apply to such cases. Consideration has to be given to the sex-chromosome constitution and to the anatomical features of the gonads, the accessory sexual apparatus and the external genitalia in order to determine what can be done with them surgically. But above all else the behaviour, attitudes and ideas of the affected child must be taken into account. That which is done must be that which will ensure that the individual concerned shall avoid as much distress as possible and shall achieve as much happiness as possible.

Sex-reversal. Several of those who have contributed notably to the development of medical cytogenetics choose to regard the phenotypic male infant who is found to be chromatin-positive as an instance of the transformation of an individual who to begin with was a female into a male. For example, Moore (1959) in a Winnepeg study of 3,715 newborn infants it was found that of the 1,911 phenotypic males 5 were chromatin-positive and therefore presumably XX in sex-chromosome constitution. It was suggested that these were females who had undergone sex-reversal and that the cause was some influence, possibly hormonal in nature, that had operated during the period fertilisation-differentiation of the gonads and had moulded the embryonic gonads into testes.

But is a zygote with the XX chromosome constitution, in fact, a female or an XY zygote a male? It is not; it is a zygote so endowed genetically that, if all goes well, it will pursue that path of development and differentiation that leads to the assumption of a female-type characterisation in the case of the XX zygote, of a male-type characterisation in that of an XY zygote. The XX zygote has the potentiality of becoming a phenotypic female but it itself is not a female. Femaleness, like maleness, is a characterisation of a complete individual, not of its compoent cells, tissues, organs or organ-systems. In other species there are plentiful examples of genes which deflect sexual differentiation from male-type to female-type and *vice versa* so that in them the sex-chromosome constitution is no indication of maleness or femaleness. An XX zygote that follows the male path of sexual differentiation from the very beginning was never a female. The only significant difference between the XX and the XY male is that the former is constitutionally homogametic and when mated with a normal XX woman can beget none but daughters.

A male, essentially, is an individual equipped for the production of male-type gametes, spermatozoa, and for the conveyance of these to the site of fertilisation.

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A female, essentially, is an individual equipped for the production of female-type gametes, ova, and for the conveyance of these to the site of fertilisation. The hermophrodite is an individual equipped for the production of both kinds of gamete and for the conveyance of these to the site of fertilisation. Maleness and femaleness are contrasted characterisations which are the expressions of different genotypes, such expression being modifiable by forces in the internal and external environments of the organism. If a gene can deflect the direction of the processes of differentiation of the sex and reproductive equipment it is to be expected that non-genetic factors, such as hormones, acting upon the same processes will produce the same effect.

In current medical literature a new terminology relating to sex is used, nuclear sex, genetic sex, chromosomal sex, gonadal sex and social sex being terms that seem to suggest that a somatic cell, the genetic constitution and the gonad can display the property of maleness or of femaleness. Social sex is the term used to define the opinion of other people concerning the sex of a particular individual. Though they may be useful such definitions tend to be misleading. The nuclear sex-chromatin test does not indicate that the cell is male or female but only that in its nucleus there is only one X-chromosome or more than one. The XY and XX sex-chromosome constitutions (1X:1Y.2A and 2X:2A) are, as a rule, trustworthy indications that the individuals concerned, can, as development and differentiation proceed, be expected to display the characterisation typical of the male individual or of the female; they do not mean that the cells to which they belong are themselves male or female. The gonads are either male-type or female-type, testes or ovaries and it is the rule that the gonads of the phenotypic male are testes and those of the phenotypic female are ovaries. The opinion of others concerning the sex of an individual can be mistaken, for a phenotypic male, capable of producing functional spermatozoa, can masquerade as a female and be accepted by society as such. All that the term social sex seems to mean is that the individual is regarded by other people as a male or as a female and that a particular individual was reared as a girl or as a boy.

Conclusion

It can confidently be predicted that in the immediate future medical cytogenetics will attract, in ever-increasing measure, the interest of those who maintain that healthiness should be the birthright of every individual. Preventive action against diseases of environmental origin will certainly continue to be successful and the time will come when similar action against defect and derangement of genetic origin will be called for. With the recent rapid development of molecular biology the biological phenomenon of organic inheritance is being explained and understood in terms of physico-chemical laws and it cannot be very long before the three fundamental questions in genetics—what is the material nature of the gene?; how does the gene replicate itself?; and how does the gene produce the character?—are fully and conclusively answered. When this knowledge has been secured it may well become possible to transmute it into the power of controlling the action of the gene and thereby deliberately controlling the characterisation of the organism.

Such intervention will require that the presence of undesirable genes in the genetic constitutions of individuals shall be detected and so for the immediate present the most important task is that of devising means for the detection of the carriers of harmful recessive genes. The second most important task is that of devising means for the treatment of defects and derangements of genetic origin, this being based upon a full understanding of the nature of the abnormality, in physico-chemical terms. Such therapy cannot affect the genotype of the individual who will transmit the gene or genes though he himself has been made phenotypically normal, a matter of no great importance if the condition can be cured or its expression prevented. In so far as those abnormal conditions, the causation of which is the interplay of genotype and environment, are concerned, it will always remain easier to bring the environmental component under control and when this is done the genetic component will remain impotent.

Other tasks for the immediate future are: to discover the incidence of genetic and partly genetic disorders in the population; to discover how much of genetically caused defect and derangement is due to repeated fresh mutation; to discover the fertility and mortality rates among individuals and families displaying the various disorders of genetic origin as compared with those of individuals and families without these defects and derangements; to add to the records of consanguineous matings and of the genetic effects in the offspring of such marriages; to discover what substances and procedures extensively employed in industry and elsewhere are mutagenic in man; to encourage the development of pharmaco-genetics since it is established that an abnormal susceptibility to a new drug can have a genetic basis, a violent and dangerous reaction being the first indication of the existence of a particular gene.

It is not to be forgotten that medicine is concerned not only with the health and well-being of those now living but also with the health and well-being of generations yet to come. It is in this connexion that medical cyto-genetics reinforces medicine. It has to be recognised that socio-economic and medical measures can in their effects alter the genetic constitution of a population by altering the frequencies of genes, by encouraging or impeding the expression of genes, advantageous or harmful. It is one of the major tasks of medicine to discover what these alterations are likely to be and to help in devising the means whereby the undesirable ones may be avoided.

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Chapter 2

PRENATAL DEVELOPMENT

ALL living creatures are the product of their heredity and their environment. This statement is so obvious that it is easy to overlook the commonplace miracle of man's normal development in all its functional and structural complexity. The study of human embryology is too vast a matter for condensation and it is the purpose of this chapter to indicate only those features of prenatal development which, directly or indirectly, bear upon the outlook and experience of the practising clinician.

A faulty genetic endowment is responsible for hereditary defects but, as a rule, congenital abnormalities result from 'a flaw, localised in space and time in some aspect of the ontogenetic pattern for which some environmental factor, acting upon a particular process of development, is to blame' (Wyburn, 1953).

Earliest Stages of Development

Three main periods of prenatal development have been described by Hamilton, Boyd and Mossman (1962):

1. From the time of fertilisation to the full implantation of the blastocyst, but before the establishment of an intra-embryonic circulation, that is to say, up to a gestational age of twenty-one days.
2. From the beginning of the fourth week to the end of the eighth week, during which all the main organs and systems are differentiated.
3. From the end of the eighth week until delivery, a period of quantitative rather than qualitative change. This is the period of growth rather than new development.

The well-known statement that ontogeny repeats philogeny, in other words that the developmental history of the individual repeats the evolutionary history of the species, is a loose statement that is true only so far as the basic vertebrate pattern goes and is best illustrated in the fate and development of the branchial arches.

Human ova are only likely to be fertilised within about the first twelve hours of ovulation but spermatozoa may retain their ability to fertilise up to forty-eight hours after their emission. Rock and Hertig (1948) studied very early human ova and embryos in hysterectomy specimens, and they found that the embryo is at the eight-cell stage within three days of fertilisation, the age at which it reaches the uterine cavity after its passage down the Fallopian tube. Invasion of the endometrium starts on the sixth day, the embryo now entering the blastocyst stage and by the tenth day it is fully embedded in the endometrium, its diameter by now being about half a millimetre. By the fourteenth day the amniotic sac has enveloped the ectoderm and trophoblastic masses on the surface, having opened up the capillary network within the endometrium, have now formed lacunae and are bathed and nourished by maternal blood. These early villi are by now beginning to receive their mesoblastic core and by the sixteenth day a system of branching villi is developing.

Blighted ovum. Rock and Hertig commented that 47 per cent of the 26 embryos which they studied, as above, were already clearly blighted in one respect or another. It has to be noted however that this high figure may be the result of indications for which the hysterectomy was done which in themselves may have constituted an unfavourable environment. Nevertheless the wastage in foetal life which occurs at this time is greater than at any subsequent period.

It is perhaps as well that nature rids itself at an early stage of such unprofitable products but the tendency to produce abnormal foetuses is exaggerated in the genetic make-up of certain parents and Malpas (1938) noted that foetal abnormality occurred twice as often in fraternities containing abortion sequences. The attempts of medical science to prevent a threatened abortion from becoming inevitable are often, for this reason, a case of love's labour lost and, as Potter has remarked, any proposed therapy for the prevention of early abortion must be directed towards the prevention of foetal death rather than the inhibition of uterine contractions since so many very early aborted foetuses have already been for some time dead before abortion finally occurs.

Specific Structure Development

The embryo now enters upon the second stage of its development having survived the first three weeks. By now its size and volume have become too great for subsistence to be maintained by the diffusion of materials through its surface and there is a growing need for a circulatory system to distribute to its different parts the materials for further development. This involves the need for blood as a vehicle, the development of vessels in which it is to travel and the mechanical force of a pump in the form of the heart in order to distribute the materials. Already by the eighteenth day blood islands and vessel rudiments are present in the chorion and its villi, as well as the body stalk, yolk sac and embryo itself. Hamilton, Boyd and Mossman state that the first blood vessels arise in the extraembryonic mesoderm. At twenty-one days a circulation of sorts is established between the embryo and the early vessels within the villi.

Heart. The development of the heart takes place between the third and eighth weeks of embryonic life by the end of which time the heart has assumed the adult configuration of a four-chambered organ. Thereafter, further development is mainly confined to the heart musculature.

In its earliest stages the heart is a relatively simple tubular structure which can nevertheless pump blood through the primitive vessels in the fourth week of life. The tube then folds upon itself as an S-shaped curve and first the interventricular septum and presently the interauricular septum grow towards each other from their original ridges to divide the heart into right and left sides. The interventricular septum closes in the eighth week but the foramen ovale of course remains open until after birth. Apart from the latter, the four chambers are fully separated by the end of the eighth week and it will be seen therefore that any structural abnormality, if it is going to occur, must be manifest before that time. This matter will be considered further when dealing with the effects of virus infections in early pregnancy.

Skin and accessory structures. Up to the sixth week the skin consists simply of a simple cuboidal epithelium but there now forms a thin layer of flattened cells on the surface, known as the epitrichial layer. In the ensuing fortnight an intermediate stratum, two or three cells thick, develops between basal and epitrichial layers and by the fourth month keratin formation begins in the superficial parts of the intermediate stratum. Shedding of the epitrichial layer now takes place progressively and is complete by the end of the sixth month. The degenerate cells so shed, together with sebaceous material, form the vernix caseosa which is held by some to have a superficial protective function. The fingerprint patterns of the palms and soles begin to appear about the sixth month. The characteristic regional differences in skin thickness are not acquired in response to local pressure effects but are well developed before birth, being

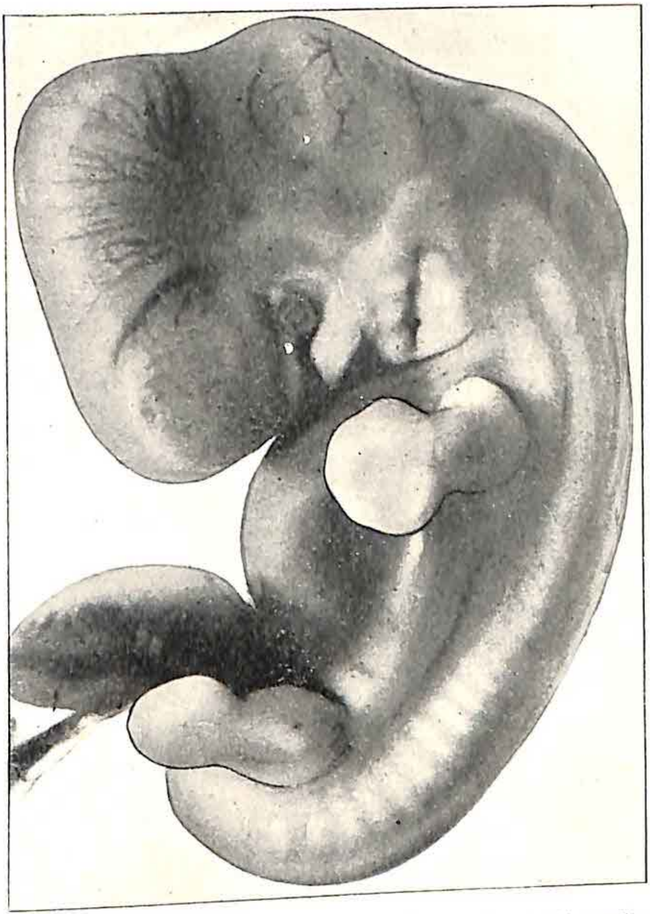


FIG. 2. Human embryo of about five and a half weeks showing the primary curve of the spine in the mesenchyme stage when cartilage is appearing in the vertebrae and ossification has not yet occurred. (No. 801 in Professor J. P. Hill's collection at University College, London. Harris, H. A. 1943. *Proc. Roy. Soc. Med.*, **36**; 300.)

genetically determined and they persist even after transplantation to a non-pressure bearing area.

The sweat glands begin to develop first of all in the palms and in the soles during the fourth month but, although their lumina are formed by the seventh month by the breaking down of central cells, they are incapable of secreting much sweat before term, a matter of some importance in the case of premature infants.

The sebaceous glands appear during the fifth month as epidermal buds from hair follicles. Unlike the sweat glands they secrete early on and their main importance in intrauterine life lies in their contribution to the vernix caseosa. Hair follicle development begins in the third month as a downgrowth of epidermis, although the eyebrows and the hairs of the scalp, eyelids, lips and chin appear somewhat later. The hairs, however, are not visible at the surface before the end of the sixth month when they appear as fine lanugo hairs. These are shed with increasing maturity of the foetus and are finally replaced by a coarser type of hair.

The nails develop from a thickened epidermal plaque which appears first at the tip of the digit at about ten weeks. This thickened area migrates to the dorsal surface at the digit and sinks below the general epidermal level especially along the proximal margin. It is from the epithelium underlying this proximal nailfold that the true nail develops and grows distally so that at term the nail reaches as far as the tip of the digit. It is not true however that very short nails are a feature of prematurity.

Urinary system. The placenta is such a good excretory organ for the foetus that there is no need, during intrauterine life, for an efficient genito-urinary system. In fact, a baby may be born alive at term with bilateral renal agenesis or a complete obstruction to urinary outflow. Compared with other special organs the development of the kidney from the metanephros occurs relatively late in embryonic life and only begins in the fifth week. Increasing numbers of glomeruli develop up to the time at which the foetus reaches a weight of about 5½ lb. or 2,500 gm. (Potter, 1961) and furthermore if a premature infant is born before that size is reached, glomerular formation continues for a time after birth. Nevertheless, even the very immature kidney is capable of secreting a dilute urine fairly early on and urine can be found in the bladder at sixteen weeks' gestation. The foetus is known to excrete urine into the liquor amnii and oligohydramnios may result from renal agenesis or from congenital obstruction to urinary outflow. The extent to which foetal urine contributes to the quantity of liquor amnii is not known, but urea can be detected in the liquor even before the sixteenth week. The lobulated foetal form of the kidney persists long after renal development is otherwise complete, *i.e.* about thirty-six weeks, and the lobulation may persist for some weeks after birth. The ability of the kidneys to concentrate urine, and indeed to demonstrate a full excretory functional capacity, is not achieved until some time after birth.

The above brief summary of events may help to explain at least some of the difficulties which the premature infant may have in controlling its own fluid and electrolyte balance after birth. Congenital abnormalities of the urinary system are so frequently associated with genital defects, and *vice versa*, that the finding of one such aberration should indicate a search for others. These abnormalities may also be associated with faulty rotation of the gut.

Gut. During the first five weeks of embryonic life the intestine protrudes with the yolk sac into the base of the cord but by about ten weeks it is reincluded within the abdominal wall. Thereafter an anticlockwise rotation occurs around the superior mesenteric axis bringing the ileocaecal region round into the right iliac fossa.

Diaphragm. The statement that the finding of one foetal defect indicates a search for others is less true in the case of fusion failures of the constituent portions of the diaphragm, although large diaphragmatic hernias are associated with pulmonary hypoplasia. The mechanical restriction of lung space, however, may have something to do with the latter. The diaphragm, incidentally, has usually fused completely by about the eighth week and, although closure may fail on either side, diaphragmatic hernias are more common on the left than on the right.

It would not be appropriate in this brief review of structural development to include mention of more than a few organs, nor would space permit it, but the above choice has been made because of the commonly encountered points of clinical interest that may present at a child's birth. For the same reason only the thyroid and the suprarenal glands of the endocrine system will be discussed here.

Thyroid. The differentiation of the thyroid is histologically demonstrable at the end of the third month of foetal life and, from six months onwards, colloid collects increasingly within the acini, although, according to Smith, there is a temporary reduction in this amount at birth. The appearance of thyroid function has been deduced by Chapman *et al.* (1948) from the earliest age at which the foetal thyroid could be observed to pick up radioactive iodine. Tracer doses of this substance were given to the mother before therapeutic hysterotomy and a study was made of foetuses ranging from seven to thirty-two weeks' gestation. Radioactivity was detected by these workers in increasing amounts from the fourteenth week onwards, but not before, so that it would appear that the functional activity of the thyroid dates from this time.

Adrenals. The adrenal glands, weight for weight as compared with adults, are relatively about twenty times larger (Smith, 1959). This is due to the fact that the adrenal cortex, during intrauterine life, consists of an outer and persisting part and much larger inner zone of foetal cortex which degenerates within the first few months after birth, whether premature or not. The function of this zone is unknown, although it was once thought that it might be androgenic and designed to counteract the feminising influence of the high maternal oestrogen supply. However, it has not been possible to extract recognisable androgenic substances from this zonal tissue so far.

The adrenals after birth become the main sources of pressor substances owing to the regression which occurs of the foetal extra-adrenal chromaffin tissues, such as the organs of Zuckerkandl (Baar, 1954). The human foetal adrenal medulla and organs of Zuckerkandl contain noradrenaline in appreciable amount but scarcely any adrenaline, starting with the fourth month and increasing until birth, and furthermore the amount of adrenaline apparently available does not exceed that of noradrenaline until a year or two after birth. It is to be noted here that noradrenaline increases circulatory peripheral resistance without accelerating the heart's action nor does it increase the metabolic rate. This may be advantageous in hypoxia at birth. Both hypoxia and the sensory disturbances inflicted by the birth process evoke the secretion of medullary substances. Adrenaline, by raising the metabolic rate, would more quickly exhaust the available supplies of oxygen than noradrenaline (Dornhorst and Young, 1952).

Adverse Environmental Factors and their Effects on Prenatal Development

Until recently it was assumed that antenatal care which was in all respects obstetrically adequate for the mother was also automatically all that could be expected for the child in utero. When therefore malformations cropped up they were accepted with sorry fatalism. But there is now increasing evidence that the child may be injured by agents which are fairly innocuous to the mother and that in those children who survive, many diseases of childhood originate in prenatal life (Warkany, 1957). More and more of the hitherto unexplained malformations are now being traced aetiologically to environmental factors and the subject grows steadily in importance as other causes of death and morbidity recede.

McKeown and Record (1960) for example, in a prospective study in Birmingham of 57,000 children from birth found an incidence of 17·3 per thousand at the age of a fortnight and 23 per thousand at the age of 5 years. McKeown (1961) also noted that the frequency of congenital malformations had doubled in Scotland in the previous decade. A fifth of all these affected children died at birth and only a half reached the age of five years. Other sources tell a similar tale. For instance in a pamphlet on malformations issued by the Ministry of Health (1963) it is reckoned that some abnormality was present in more than 1 per cent of children surviving to the age of a year. Twenty per cent of stillbirths were found to be deformed; likewise an unknown number of abortions. Conversely this same report computed that about 15 per cent of cases of congenital abnormality are stillborn and a further 30 per cent die in the first twelve months. About half survive to over the age of five years. In rough figures it can be reckoned that about one in every fifty babies is born malformed in some degree.

It is now becoming clear that healthy prenatal development can be interfered with even before conception. Quite apart from the purely hereditary disorders from genetic causes, some of the smaller chromosomes, and in particular the sex chromosome pair may suffer loss or reduplication, particularly at meiosis, which produce a number of well recognised malformations *e.g.* Turner's and Klinefelter's syndromes, the 'super' female and so forth. Major damage to the larger chromosomes producing non-viability (Ford, 1960), and structural defects, for example in the arrangement of chromosomal segments, are likely to be increasingly recognised in other abnormal syndromes (see Chapter 1). Bacsich (1964) has classified abnormalities into three main groups; 10 per cent are due to genetic factors and traceable in the family history, 10 per cent are due to some chromosomal aberration and the vast majority, namely 80 per cent are due to some extraneous teratogenic factor. Anatomically he classifies them under the following headings:

1. Arrestation, resulting in either failure of differentiation or failure of development.
2. Failures of fusion, for example, cleft palate and spina bifida.
3. Failures of the normal and expected atrophy with the persistence of some

structure for which there is no further use in adult life. Such lesions concern particularly the heart and the urogenital organs.

4. Failures of canalisation, particularly in the gut and Mullerian system.
5. Failures of migration, for example imperfect descent of the testicle.
6. Duplication of structures, for example ureters, digits, etc.
7. The abnormal hypertrophy of a given organ.

In addition to this formidable list Bacsich goes on to point out that metabolism itself is controlled by a mosaic of enzymes which are under genetic control. Defect in a specific enzyme system may produce aberrations of molecular structure or inadequate synthesis of an essential protein, or the accumulation of a metabolite. These inborn errors of metabolism are usually inherited as Mendelian recessive characters.

From conception onwards until the completion of organ differentiation at the end of the third month foetal development is exposed to teratogenic hazards of which the best recognised are certain viruses (which readily traverse the placenta), hypoxia, changes of temperature, toxins, ionising radiations, hypervitaminosis A, and certain hormones. The list grows with the years. The resulting defect depends not only upon the teratogenic insult and the severity thereof but its exact timing for selection of the vulnerable organ at that particular moment of differentiation. For example, whatever may be the genetic aetiology of anencephaly several adverse environmental factors must also operate such as the time of year, pregnancies conceived in early summer having a much higher incidence than those conceived at other times. Anencephaly is reckoned to be thirty times more common in families previously so affected and the writer has experience of an unfortunate patient who had three consecutive anencephalic monsters. Nevertheless, it is considered by Giroud (1960) that some factor operates about the sixteenth day of gestation and certainly not after the twenty-sixth day. This would be equivalent to gastrulation time in rats and mice. Anencephaly would appear to be particularly common in the Irish race and it has been suggested by Green (1964) that exposure to influenza virus may be a factor. This would be more often expected in disagreeable climates such as the West of Scotland and the Emerald Isle.

Congenital abnormalities can be experimentally produced in animals by means which have not yet been satisfactorily demonstrated in humans, for example, the absence of trace elements, or excessive or deficient amounts of certain vitamins. In pregnant sows hypovitaminosis A produces absence of eyes and cleft palate in piglets. This is a subject in which species difference makes it very difficult to make direct inferences.

The effect of drugs administered in early pregnancy came sharply to notice with the thalidomide catastrophe. Here was a drug which had been amply tested out on animals and had already had wide use as a sedative in elderly and depressed patients without ill effect. This apparently harmless drug first appeared in Western Germany in 1954, but it was not until 1958 that the first baby victim was recognised, suffering from absence of upper and lower limbs. More cases in West Germany were then reported and 34 newborn affected infants were presented at a paediatric meeting in Dusseldorf at about this time, and it was Lenz of Hamburg who drew attention to the possible association of thalidomide and phocomelia and associated lesions of the ears and gastro-intestinal tract. It further appeared that a single dose was capable of producing such deformity provided that it was taken between the thirty-seventh and fiftieth day since the onset of the last menstrual period. Nearer home a similar disaster overtook a number of pregnant women and their babies and there was quite a crop in a small town, namely Stirling, where thalidomide had come to be prescribed in early pregnancy, and reports such as those of Speirs (1962) and others began to grow in number. The manufacturers very promptly withdrew the drug from the market at the first sign of trouble but, even so, there are to date still about 350 babies in the United Kingdom surviving with serious limb defects attributable to this drug. In Western Germany the situation is almost five times as serious.

Following this terrible discovery a great number of other drugs came under suspicion, including meclizine and tolbutamide, but his has never been fully confirmed. Metranidazole, used in the treatment of trichomonas vaginitis, was also suspect without confirmation, and by now there must be an enormous number of women who have been treated for this very common complaint with this drug which must have been exhibited in very early pregnancy so that there should have been ample time for an association to be revealed to a profession now thoroughly on the alert. Curiously enough tetracycline has been found to produce a yellow discolouration of the teeth of the first dentition in children, and since it is known that this antibiotic is readily incorporated into rapidly growing cells it is surprising that other effects have not yet been demonstrated. Nevertheless it is an antibiotic which we have now abandoned in pregnancy for this reason.

Aminopterin, the first of the folic acid antagonists, and nowadays regarded as too toxic for clinical use, was found to produce various types of foetal abnormality, foetal death or abortion. Its successor amethopterin (which might be used in the treatment of a case mistakenly believed to have a recurrence of choriocarcinoma, who, in fact, had started a normal pregnancy) might be expected to produce a very damaging effect but evidence of this is not yet forthcoming and the cases in any event must be rare indeed.

Drugs used in the treatment of thyrotoxicosis such as thiouracil and the iodides may produce foetal goitre, but this is more a compensatory phenomenon which remits spontaneously after the child is born.

Some of the newer and more potent progestational agents have a virilising effect on a female foetus. The fact that the same drug can be androgenic to a foetus and yet progestational in its effects on the mother is believed to be due to different enzyme actions and organ maturity.

Cortisone and the adrenal steroids have, in a number of cases, been held responsible for cleft palate by interfering with fusion in embryonic development, but these cases are in a minority of the many receiving this type of treatment.

It is clear, as Bacsich has summed up, that drugs in general are not important factors in congenital malformations and, in fact, very few drugs have been observed to be teratogenic in spite of a regular witch hunt in recent years. Because of species difference animal experiments are of very little help in predicting hazard. The reason for prescribing a drug, for example for bleeding, etc., may be more important in its effects on the foetus than the drug itself. For an agent to have teratogenic properties it must have some specific relationship to the metabolic and homeostatic needs of the embryo at the time of administration (Mellin, 1964). Furthermore susceptibility even at such a time may itself be determined by genotype. Mellin further reported a survey carried out prospectively in about 3,200 pregnancies in New York on prenatal influences on foetal development and survival, and noted with some cynicism, that often the drugs prescribed and recorded on the hospital chart differed from the drugs the patient actually took, that the prescribed drugs were sometimes not taken, and that at other times drugs which were not prescribed were obtained from outside sources. He found, further, that although the number of individuals using any specific drug in the first trimester of the pregnancy was small there was no striking discrepancy between the malformation and the control groups.

Significant amounts of irradiation if given early enough in pregnancy may kill the foëtus, a little later may deform it through microcephaly and later still may increase its chances of developing leukaemia or some other form of malignant disease in childhood.

The importance of episodes of severe hypoxia in early pregnancy is often overlooked, especially where abortion following intra-uterine foetal death is not thereby provoked. Instances of this result from attempts at suicide by carbon monoxide poisoning or barbiturates. Ingalls (1960) cites three instances of ectromelia caused by this means.

Research into what Warkany (1957) called the 'wide and empty spaces which lie between obstetrics and paediatrics' has been carried a stage further by Woolam and Millen (1960) who studied various methods of modifying the known teratogenic affects of hypervitaminosis A and X-radiation. The former probably produces its effects by interfering with foetal carbohydrate metabolism and they noted that while cortisone and methyl thiouracil accentuate the effects, insulin, thyroxine and the vitamin B group reduce them. The deleterious effects of X-rays on the other hand are increased by thyroxine, insulin, cortisone and large doses of vitamins but are mitigated by cysteamine given prior to but not after the exposure. The sensitivity of foetal tissues was also dependent upon oxygen tension.

It is certain that endocrine disorders may influence prenatal development and latent endocrinopathies such as pre-diabetes are already regarded as causing an increased incidence of foetal abnormality. In frank diabetes the increased incidence of foetal abnormality has been long recognised and Pedersen *et al.* (1964) in Denmark noted the abnormality rate was three times as high in diabetics at 6·4 per cent as in controls, but they further remarked that the incidence was highest where there were vascular complications as well.

Virus infections in early pregnancy. It is when we come to consider the effects of viruses on the developing embryo that the most striking advances in our knowledge to date are apparent.

In clinical medicine infections are usually identified by the nature of the tissue response evoked, that is to say, by the varieties of the physical signs of inflammation, including leucocytosis, but in the case of the very early foetus, for example before the tenth week, these responses cannot be made. Instead either the foetus dies or the rapidly differentiating organs suffer some aberration in their development. Leucocytosis is not possible in the very early foetus and Potter states that the first signs of abnormal collections of leucocytes are to be found in the pulmonary tree as late as the sixteenth to the eighteenth week (before alveolar development).

The role of virus infections came suddenly to notice with Gregg's observations in 1941 in Australia. He noted in 78 cases of congential cataract (which was usually bilateral and frequencly associated with microphthalmia) that there was a history of maternal rubella during the first two months of pregnancy in all but 10 cases. This important finding has since led to an intensive search for possible effects of other virus infections on the early human embryo. The Australian rubella epidemic was a severe one, but it is important to know what the chances are of serious damage to the foetus in the case of a woman contracting rubella in early pregnancy. As it is, estimates of foetal abnormality vary between 15 per cent (Swan, 1948) and 40 per cent (Kaye, Rosner and Stein, 1953) and the degree of incapacity also varies widely. The evidence in regard to the exanthemata however is less concrete.

The prospective survey instituted by the Ministry of Health has been summarised by Manson *et al.* (1960) in which some hundreds of affected cases were matched by controls, and it would appear from this that not only is the death rate *in utero* and up to the age of two years more than doubled when rubella is contracted by the mother within the first 12 weeks but the abnormality rate is raised in the case of the incidence of congenital heart disease to approximately 20-fold, cataract 100-fold, deafness more than 30 times and mental deficiency about quadrupled.

Rubella is only effective in this respect in early pregnancy and does not affect the baby at birth from infection *in utero*. The eyes, the ears and the heart are particularly susceptible. In the case of the first, the lens starts to develop at the beginning of the second month as an area of thickened ectoderm and new fibres are formed peripherally throughout early life. It is the innermost portions of the lens which are affected by rubella *in utero*, resulting in cataract. Other congenital abnormalities of the eyes, such as congenital glaucoma due to the failure of the canal of Schlemm to develop and congenital coloboma due to failure of the choroidal fissure to close, are less characteristic effects of this disease, although microphthalmia is common. The period of vulnerability of the organs of hearing is slightly later than in the case of the ocular structures. Although, by the end of the second month, the face is complete, including the appearance of the external ear and all the essential parts of the inner ear are being differentiated, the organs of Corti which are the end-organs of hearing are vulnerable during the third month and the middle ear structures likewise. Potter has drawn attention to the fact that eye and ear defects are unusual in the same baby, presumably due to the fact that their periods of vulnerability do not overlap, so that whereas eye defects occur when rubella develops within the second month of pregnancy, ear defects tend to occur a bit later when the infection occurs late in the second or early in the third month. The structures of the middle ear develop about the same time as the organ of Corti and are likewise vulnerable.

The cardiac lesions most commonly produced by maternal rubella are, according to Campbell (1961) patent ductus (58 per cent), ventricular septal defect (18 per cent), atrial septal defect, pulmonary vascular stenosis and Fallot's tetralogy (each 6 per cent). Mental defect and microcephaly are fortunately less common still, a point to be remembered when the question of therapeutic termination of pregnancy is considered.

It is surprising that rubella alone appears to be the chief offender considering the ease with which viruses are known to cross the placenta. Indeed the common exanthems may appear in the mother and baby at the same time. The foetus may indeed be affected directly by such viruses as that of rubella and human cytomegalovirus (H.C.M.V.) but more often the effect may be indirect due to the severity of the illness of the mother. For example, in the 1918 influenza epidemic the abortion rate was reckoned to be 26 per cent in the pregnant women so affected, but, if the influenza was complicated, the abortion rate was raised to 52 per cent and in fatal cases it was 62 per cent (Medearis, 1964). Maternal pyrexia probably contributed to this as well.

When a virus directly affects a foetus by invasion it may produce abortion, premature labour, stillbirth, neonatal death, with or without foetal abnormality and in those that survive birth there may be permanent handicap. In the human, rubella and H.C.M.V. produce a true viraemia, whereas toxoplasmosis and syphilis, for example, have to get into the foetal system by destructive degrees, affecting placenta and liver first. Medearis has pointed out that the foetal handicaps in an infection consist of a slower or very indifferent immunoglobulin response, poor macrophage mobilisation, diminished interferon synthesis and that a relatively greater number of tissues possess specific receptor sites for the action of a virus. There are also less effective barriers, for example, between blood and brain.

In the case of virus infection those organs in a critical state of development are the most vulnerable to a destructive process. If rubella is contracted in the first twelve weeks the abortion rate, at about 5 per cent, is not much greater, the stillbirth rate may be raised and the infant mortality under two years of age rises to 6·9 per cent, of whom 46 per cent have some congenital abnormality. Of the survivors beyond the age of two, 4·7 per cent can be expected to have some form of congenital heart disease, a similar number may have cataract and 6·6 per cent may be deaf. There is now some doubt that the administration of gamma globulin to the susceptible mother who has been exposed to risk in early pregnancy in fact protects her (Medearis).

The proportions of congenital malformations caused by rubella and all the viral infections is reckoned to be less than 10 per cent. Nevertheless the present enthusiasm of parents to get their daughters infected with rubella before they reach marriageable age may be all very well for their own families but may inadvertently expose others in early pregnancy with whom they come in contact.

Cytomegalic inclusion disease caused by the human cytomegalo-virus produces a clinically inapparent infection in the mother. Fortunately the majority of women have already been infected before pregnancy (as in the case of toxoplasmosis) otherwise the infection would be more common in the foetus. It is curious, however, that the risks here are most common after the fifth month of pregnancy and in an active infection both the mother and foetus have the same virus. The baby is affected with jaundice with a raised bilirubin and hepatosplenomegaly. There is also thrombocytopoenic purpura and pneumonitis. Mental retardation is also a sequel. Focal lesions in the central nervous system are demonstrated by inco-ordination and spasticity. Immunity acquired at the time prevents the affection of subsequent babies.

Vaccination risks. This invites one to inquire into the advisability of vaccinating women in pregnancy. Macarthur (1952) reported a case of a premature child born with generalised vaccinia from which it died. The mother had received a primary vaccination some months earlier. This led him to analyse the pregnancy outcome in 203 cases in which vaccination was carried out during or immediately before pregnancy. He found that there was only 1 foetal loss in 33 cases vaccinated during the first four weeks but of 24 women vaccinated in the second and third month of pregnancy who went to term, no less than 5 had stillbirths; moreover, abortions, foetal abnormalities and neonatal deaths brought the total of foetal loss up to 27 per cent in 67 cases vaccinated during this period. It would appear, therefore, that the risks to the foetus of vaccination between the fourth and twelfth week of pregnancy are considerable, particularly in primary vaccination.

Sex Development

The development of sex in the foetus is autonomous and does not depend upon the internal secretions of the mother. The genital system makes its appearance between the fifth and sixth weeks. This is the stage of the indifferent gonad which consists of a superficial germinal epithelium and internal blastema. Differentiation of the testes starts about the seventh week and of the ovary rather later, about the eighth to the ninth week.

The sex of the embryo is, of course determined from the outset by the chromosomal characteristics of the spermatozoon responsible for fertilisation (see Chapter 1).

The testis begins its descent to the scrotum at the seventh month. It remains for a while at the internal abdominal ring until the rising intra-abdominal pressure encourages its descent down the inguinal canal. Normally it reaches the scrotal sac by the end of the eighth lunar month (Hamilton, Boyd and Mossman), although this is variable.

Diet

Although adequate, or more than adequate, diet is all important for the well-being of the pregnant woman, the foetus is less readily affected by deficiencies in maternal nutrition. It is, after all, the complete parasite and helps itself to the best of all that is going, if necessary at the expense of its mother. All this is certainly true of the first half of pregnancy, but rather less so in the second half.

Barcroft observed in sheep that it made little difference to the weight of the foetus whether the diet were severely restricted or not for the first ninety days out of the hundred and forty-four days of the sheep's pregnancy, but that diet became more important during the latter part. As far as birth-weight goes, the human foetus is likewise affected and Smith (1959) considers that the birth-weight will be normal provided that the diet is adequate at the end of pregnancy. In any case the foetal weight at term is unlikely to be seriously affected by dietary deficiencies unless malnutrition is extreme and the maternal calorie intake is consistently less than 1,800 calories a day. It might be pointed out, however, that birth-weight is by no means the only factor to consider and that the baby's vigour is of more importance to its healthy survival than its size. The poorer classes of society, who are for that reason less well nourished than the more well-to-do, have been shown by Baird (1945) to have a higher prematurity rate, so that the factor of prematurity comes into considerations of birth-weight in relation to diet.

The rate at which the foetus acquires and retains nourishment from its mother progressively increases *pari passu* with its maturity and growth so that its demands may not be fully met within the last twelve weeks of pregnancy and in the case of vitamins and minerals it may go short if the maternal stocks of these substances are very low. Because both the uptake and the needs of the foetus are greater in the last weeks of pregnancy it will be readily seen why premature infants have a greater liability to develop rickets.

Two mineral elements, namely iron and calcium, deserve special mention here, although they will be considered more fully presently. During pregnancy the mother develops a positive calcium balance of about 50 g. and maternal nutritional deficiencies in calcium and vitamin D are now believed to affect the child's subsequent dental health more than the child's own diet later and likewise the seeds of rickets are often sown *in utero*. With regard to iron, quite apart from the well-known tendency of the pregnant woman to develop an iron deficiency anaemia, the foetus itself has to lay down an iron store and the maternal diet, to meet the needs of both mother and foetus, should not contain less than 15 to 20 mg. of iron a day. From the baby's point of view the maternal intake of iodine should also be adequate since a deficiency of this substance is likely to cause hypertrophy of the foetal thyroid gland.

Foetal calcium. With the acceleration of foetal growth towards term calcium is laid down in increasing amounts, so that at birth the total foetal calcium is about 21 g. with more than half of this acquired during the last two months of pregnancy (Smith). After birth there is a negative calcium balance for a time until the child's intake of milk rises sufficiently to counter it. The phosphorus acquired by the baby also increases in the later part of pregnancy although the increase in storage is less pronounced.

Foetal iron. The foetus of a woman who suffers from anaemia usually has a normal haemoglobin level at birth but some months later it may show a tendency towards an iron deficiency anaemia due to a previous deficient storage of this substance, a lack of which will not be made good during neonatal life since milk is an inadequate source of iron. The speed with which the foetus can absorb iron from the mother is truly remarkable as Pommerenke and his colleagues (1942) showed. These workers gave radioactive iron by mouth to mothers and were able to detect it in the foetal circulation in less than an hour. From this they concluded that there would not have been time for the iron to have been first incorporated in the haemoglobin molecule in the mother before transference to the baby and that the plasma itself must be the vehicle for its transport. They further considered that the rate of absorption of iron is determined by the organism's need of it. About 60 per cent of the iron is held within the blood and the remainder in storage depots.

The ability of the maternal plasma to carry iron increases in pregnancy from about 300 mg. to 450 mg. per cent, but in actual fact the serum iron drops from 100 mg. to 80 mg. per cent, this drop being associated with the formation of haemoglobin, a process in which the baby is also participating. The foetus at birth has an iron carrying capacity of 225 mg. per cent but the serum iron averages 150 mg.

At birth a normal infant contains about 350 mg. of iron, rather less than half being laid in store, particularly in the liver, during the last three months of pregnancy. The effects of a deficient iron storage are only manifest some weeks after birth since erythropoieses greatly diminishes after the child is born and haemolysis adds to the stores of iron.

Foetal Blood-Sugar and Maternal Diabetes

Since glucose very readily diffuses across the placenta, foetal blood-sugar *in utero* is closely related to, though lower than, the levels of maternal blood. But shortly after birth, even in the normal case, the baby's blood-sugar may be 40 mg. per cent or even less, and lower still in the premature infant. This occurs whether the mother has diabetes or not and in the past hypoglycaemia has been wrongly postulated as a cause of the increased neonatal death rate following diabetic pregnancy. This hypoglycaemia was formerly explained by a hypothetical hyperinsulinism which the foetus had protectively developed against the high maternal blood-sugar but this explanation is altogether too facile since the same train of events may occur in pre-diabetic pregnancy.

Sudden attacks of hypoglycaemia may be a cause of symptoms at the age of one or two days in babies of even normal mothers and may be manifested by sudden and unexplained collapse of the baby. This is now increasingly recognised and the response to the intravenous injection of glucose is dramatic. It is difficult to explain why these attacks should occur out of the blue, but the exhaustion of glycogen stores in labour and as the result of asphyxia may be a possible cause.

As Potter has observed, the Islets of Langerhans are increased both in size and number in the foetus in diabetic pregnancy but this hyperplasia occurs regardless of the severity of the maternal diabetes or the thoroughness of its therapeutic control. The high blood-sugar levels obtaining cannot therefore be regarded as the stimulus to the beta cells of the islets since the degree of hyperplasia is not related to the level of the blood-sugar and, furthermore, the same happens in pre-diabetes. It would appear, however, that the increased carbohydrate from the mother, together with an increased foetal production of insulin is probably responsible for some of the fatness of these babies relative to their maturity.

It is much more likely that the same hormonal stimulus acts both upon the Islets of Langerhans and upon the degree of foetal growth, and Young (1951) indicated that growth hormone, diabetogenic hormone and pancreatotrophic hormone may be one and the same substance and that for the growth hormone to operate, additional insulin operating within an adequate blood-sugar range must be produced by the pancreatic islets. The hormone preferentially produces growth rather than diabetes so long as further growth is possible and in the foetus this is exactly the case. The above observations help to explain the large size of babies born to pre-diabetic mothers.

The low neonatal blood-sugar has been explained by the observation in animals that the concentration of insulin within the pancreas is higher than in later life, always supposing that this insulin is capable of being released. Animal foetuses are very insensitive to insulin and this is also true, to a large extent, of human foetuses and they do not suffer the usual effects of hypoglycaemia. The injection of insulin into the foetal circulation of an animal does not reduce the maternal blood-sugar and it is unlikely therefore that the foetus in any way contributes to the mother's supplies of insulin nor that it helps in the control of her diabetes (Young, 1951). In fact, very often the diabetic mother's insulin requirements diminish after delivery.

Landmarks in Foetal Development

The estimation of gestational age in early pregnancy is most readily, though roughly, done by a measurement of crown rump lengths and a simple rule is that given by Hamilton, Boyd and Mossman as follows: At thirty-five days the C.R. length is 5 mm. and from thirty-five to fifty-five days of gestation the C.R. length increases by 1 mm. a day and from the fifty-fifth day about 1·5 mm. daily. At least a half of the baby's birth-weight is gained within the last twelve weeks.

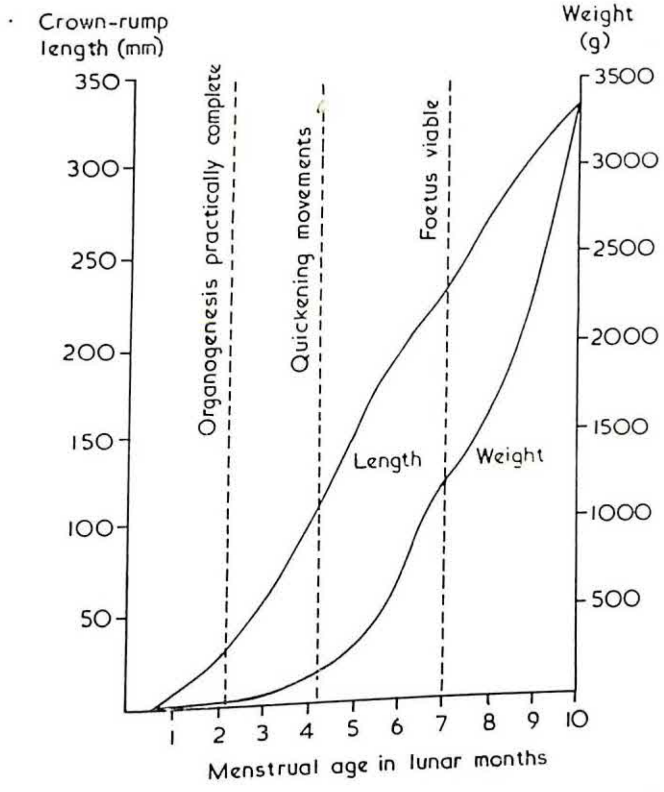


FIG. 3. Diagrammatic representation of foetal growth in relation to menstrual age. (From various data.)

The early landmarks of development are detailed in the table of correlated human development in Arey's *Developmental Anatomy* (1965), but it is in the second half of pregnancy that the landmarks are less certain but clinically more important. Meconium is present at the beginning of the second half of pregnancy and consists of lanugo hairs and cornified squames which have been swallowed, the desquamated cells of the intestine and the secretions of liver, pancreas and succus entericus.

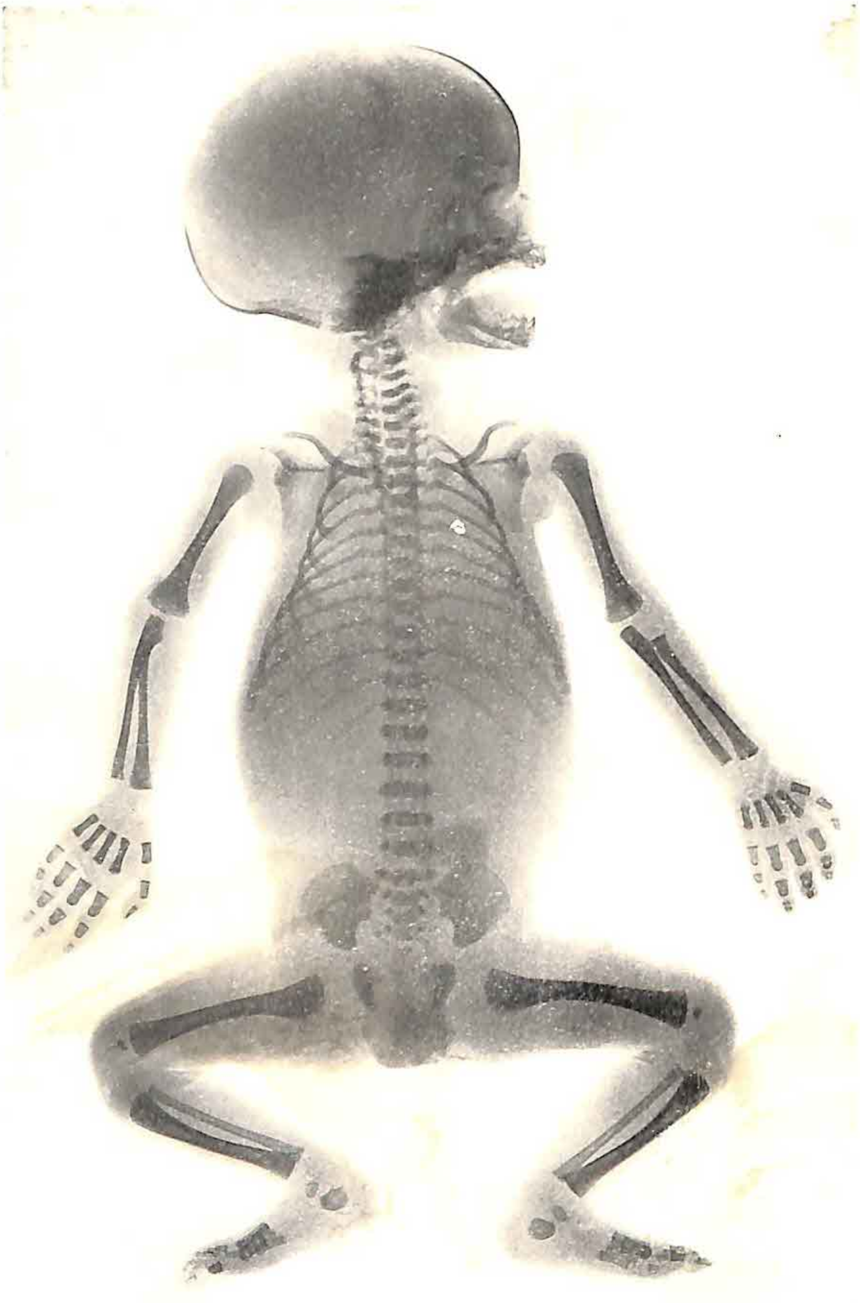


FIG. 4. Radiograph of full-term newborn infant. The centre of ossification in the distal epiphysis of the femur appears about two weeks before term. (Professor H. A. Harris.)

At the twenty-eighth week of gestation lanugo begins to disappear from the face and the nails are well formed and by the thirty-second week the face is clear of lanugo. At this stage the umbilicus is below the mid-point of the total foetal length and subcutaneous fat is very scanty. A baby so prematurely born has consequently a very unstable temperature control, aggravated further by deficient sweating, a large surface area relative to volume and less muscular activity with which to generate heat and furthermore is liable to overswings of temperature in attempting to adjust itself to its environment. At the thirty-sixth week lanugo begins to disappear from the body and the subcutaneous fat increases in amount. At about this time the insertion of the umbilical cord will be found to be approximately at the mid-point of the baby's total length.

The estimation of maturity, however, is particularly important while the child is still *in utero* and it is on this very matter that we are often badly at sea. The clinical impression of foetal size is notoriously liable to be mistaken even in the hands of the most experienced obstetricians and attempts to gauge maturity by the radiological appearance of ossification centres is about the best that we can do in the absence of a perfectly reliable menstrual history, which is nevertheless often lacking. The ossification centre of the cuboid usually appears at term and is perhaps the most reliable centre indicating maturity. The centre at the upper end of the tibia also appears at about term and that at the lower end of the femur somewhat earlier but there is a plus or minus error of at least a fortnight with these centres, let alone others less constant.

It is a pity that X-ray cephalometry is still such an inexact science because some help might be obtained from a study of the biparietal diameter, which increases by about $\frac{1}{10}$ of an inch every week, from 3 inches at the thirty-second week to 3·75 inches at the fortieth week. We have, however, developed a method of biparietal cephalometry by ultrasonic echo-sounding (Donald and Brown, 1961). This method has been extensively exploited by Willocks *et al.* (1964) in the study of growth curves as evidences of placental sufficiency in as much as it is argued that a baby capable of demonstrating further growth cannot yet have outrun its placental reserve. Foetal development and placental activity may also be inferred to some extent from the excretion rates in the urine of steroids, particularly pregnandiol and even better, oestriol, but as Klopper (1963) has pointed out, the elaborateness of the methods, which is in direct proportion to the accuracy of the results, seldom furnishes the clinician with guidance in time to influence clinical management. As it is, the present inability to assess maturity accurately before birth continues to give rise to mistakes in practice, so that often pregnancy is therapeutically terminated earlier than intended. The diagnosis of postmaturity after birth cannot be definitely sustained unless the total foetal length exceeds 54 cm.

Foetal Blood

As already stated, the development of the blood starts very early in pregnancy, with the need for a circulation system when the child outgrows the nourishment which it can receive through its surface. Up to about the tenth week about a quarter of the red cells are primitive and show nucleated form but maturation proceeds apace so that by the twentieth week, only 1 per cent of the red cells are nucleated. From now on the blood is qualitatively similar to that after birth (Smith).

The number of red cells and the level of haemoglobin are not significantly higher at term than in premature infants and he does not consider the evidences certain that the 'anoxia of postmaturity' stimulates additional erythropoiesis. Walker and Turnbull (1953), however, are more definite about this. They state that the haemoglobin levels rise steadily from 9 g. per cent at the tenth week to 14 to 15 g. by the twenty-second to twenty-fourth week. Thereafter they were not able to examine many cases between the twenty-second and thirty-sixth week but they found that in the last four weeks the level tended to rise with variations from 15 to 18·6 g. per cent at term, the mean value being 16·5 g. The rise in level, moreover, continues beyond term and ranges from 16·8 g. to 20·5 g. (mean 18·8 g.) at the forty-third week in postmature pregnancy. Similarly, they found that the red cell count rose from 1,420,000 at ten weeks to 3,280,000 at twenty-five weeks' gestation. The rise then continues slowly until the thirty-sixth week and thereafter becomes more variable with a mean value of 4,350,000, continuing progressively up to the forty-third week, in postmaturity. Of particular interest is the fact that they noted a gradual fall in oxygen saturation of the blood in the latter part of pregnancy as the haemoglobin concentration and red cell count rose. In fact, they regard this fall in the oxygen supply as proportional to, and concomitant with, a rising haemoglobin and red cell count, the tendency being particularly marked after forty-one weeks' gestation.

Most of us are now agreed that postmaturity is associated with mounting foetal hypoxia and this adverse trend is even more pronounced in other asphyxiating conditions, for example, pre-eclamptic toxaemia and hypertensive states.

After delivery there comes a halt to the rapid increase in erythropoiesis so that by the second week of life no extramedullary sites of blood formation remain and erythropoiesis is wholly confined to the bone marrow. In prematurity, because of the immaturity of the liver, prothrombin levels may be lower than later so that the premature infant has consequently an increased tendency to haemorrhagic disease.

At birth the baby is endowed with far more haemoglobin and red cells than it needs for the immediate present but the iron made available by the physiological haemolysis which follows birth is stored to meet the iron famine which is likely to result from a purely milk diet. The extra blood therefore which can be saved by late tying of the cord at birth, though not needed at the moment, may come in useful later on as a source of storage iron.

Placental blood flow and oxygen transfer. The placenta is a much less efficient organ for the transfer of oxygen than the lung and from the twenty-eighth week of pregnancy onwards it is in reality an ageing structure. Barcroft showed the increasing difference in pressure in umbilical artery and vein as the foetus became more mature, thus indicating an increasing vigour applied to the placental circulation for which, presumably, there is increasing need. Quite apart from the areas of infarction which normally occur, small areas of calcification in the placenta are occasionally demonstrable radiologically.

An ingenious mechanism has been described within the placenta by Hamilton, Boyd and Mossman, namely the arrangement whereby the foetal and maternal circulations in close proximity to each other run in opposite directions. As a result, the maternal blood which is on its way to leaving the placenta, and has therefore parted with most of its oxygen, comes into contact with the sub-oxygenated foetal blood arrived freshly on the scene, and conversely, the now oxygenated foetal blood on its way towards the umbilical vein is contiguous with the newly arrived maternal blood rich in oxygen supplies. It will be seen, therefore, that a transfer of oxygen from mother to foetus, and likewise a transfer of carbon dioxide from foetus to mother, progressively occurs throughout the placental circulation without a static equilibrium being built up or any encouragement to reverse diffusion.

Foetal haemoglobin. Barcroft and his colleagues in 1934 published their findings from a study of foetal respiration in the goat and compared the oxygen dissociation curves of the blood of the mothers with those of foetuses ranging from ten weeks' gestation to maturity. They found that the oxygen dissociation curve of the mother was always to the right of the foetal curve. In other words, at a given pressure of oxygen, comparable to that of the maternal blood, the percentage oxygen saturation of the foetal blood was consistently higher. The curve, however, at the lower ranges of oxygen pressure is steeper in the case of the foetus and consequently oxygen is almost as readily given up as in the case of adult blood.

These differences in oxygen dissociation characteristics of foetal and maternal blood are explained by the existence of two sorts of haemoglobin, namely, foetal and adult, and Smith has described the following characteristics of the former. Firstly, it has a greater affinity for oxygen. Secondly, it differs immunologically from adult haemoglobin. Thirdly, it behaves with different mobility characteristics on electrophoresis. Lastly it has a greater resistance to denaturation by alkali and this forms the basis of tests for detecting it readily.

Some adult haemoglobin is present before five month's gestation and increases to approximately 15 to 20 per cent at term. The proportion of foetal haemoglobin falls progressively thereafter. The provision of foetal haemoglobin facilitates the uptake of oxygen in the placenta.

As might be expected, the premature infant is born with a greater proportion of foetal haemoglobin than the mature baby and since the red cells already containing foetal haemoglobin will continue in circulation for the remainder of their life span—that is to say, for up to four months or over—the conversion of the premature infant's haemoglobin from the foetal to the adult variety will only gradually take place as new red cells with new haemoglobin are formed.

Maternal placental circulation. This has been studied by Browne and Veall (1950) by means of an isotope technique. The placental site is first identified by means of an intravenous injection of radioactive sodium. A few days later, after the effects of the first injection have worn off, a further quantity of radioactive sodium is injected directly into the choriodecidual space, whereupon the rate of disappearance of radioactivity from the placental site (which normally occurs with the characteristics of an exponential curve) is used to calculate the maternal placental blood flow. These workers have found that in pre-eclamptic toxaemia and hypertensive states the blood flow rate is markedly reduced, a finding which helps to explain the not infrequent instances of foetal asphyxia and intrauterine death in these complications of pregnancy. These experiments also help to explain the relative failure of babies in a pre-eclamptic environment to grow. Browne has also sought to demonstrate a similar mechanism in postmaturity, since perinatal mortality is approximately trebled in marked degrees of this, the disaster being usually attributed either to a decreased placental permeability to oxygen or an increased demand for this gas by the growing foetus which the placenta is unable to meet. The findings are not, however, conclusive since post-maturity and dysmaturity are by no means the same thing.

Placental Transfer of Non-gaseous Substances

The placental transfer of the elements of nutrition, normally present in circulating maternal blood, is taken more or less for granted and, as a rule, these substances reach the foetal blood in concentrations naturally somewhat less than in the maternal blood. It is not yet known, however, what the levels of such substances are in foetal tissues and the question of possible differences in tissue affinity in the foetus may yet have to be taken into account.

It is of more practical interest to consider some of the hormones and drugs that reach the foetus from the mother and affect it markedly. Three factors have here to be considered, though admittedly there is yet much to be learnt about them. Firstly, the sensitivity of the foetal response; secondly, the effect which these substances may have upon placental circulation and the consequent possibility of anoxia; and thirdly, the side effects so produced, so that unless chemical estimations are possible it is difficult to make categorical statements. As Maureen Young has pointed out, studies with regard to the action of substances on the intact foetus *in utero* are often made difficult by the contraction of the placental circulation in the experimental animal which occurs when the uterine wall is incised.

Adrenaline and noradrenaline. For example, Dornhorst and Young (1952) have attempted to establish whether adrenaline and noradrenaline cross the placenta. Now, as it happens, the placental vessels are very sensitive to these substances, whereas the foetus (guinea-pig) receiving a direct injection into the umbilical vein is shown to be relatively insensitive. Such pressor response as is obtained via the mother is regarded by these workers as due to interference with the maternal placental circulation. This results in foetal anoxia so that there occurs firstly a slight rise in blood pressure, due mainly to the contraction of the uterus, followed by a fall due to the reduction in placental circulation, aggravated by consequent oxygen starvation. It is therefore impossible by this method to make a conclusive estimate of the degree to which these substances are transferred across the placenta and they regard the amounts so reaching the foetus as probably insignificant. Furthermore, any associated rise in blood-sugar in the foetus is due to a corresponding rise in the mother rather than to the direct action of the adrenaline or noradrenaline upon the foetus.

Pitressin, angiotonin, etc. In the same way it is difficult to estimate the placental transfer of pitressin, angiotonin, renin, acetyl choline and histamine because of the interference of direct effects upon placental circulation, but it would appear that these substances do not cross the placenta in significant amounts. The behaviour of the foetal blood-sugar in relation to maternal diabetes and insulin has already been discussed.

Cortisone. Cortisone does not appear to interfere with the foetus in therapeutic doses although very large doses may cause abortion and the possibility of some embryonic fusion failure, for example cleft palate, should be borne in mind.

Thyroid and antithyroid substances. Both thyroid hormone and antithyroid substances can cross the placenta but their effect is variable (Peterson and Young, 1952). Signs of thyroid deficiency in the infant therefore only reveal themselves some weeks after birth. It has also been noted that thiouracil products given to the mother may cause hyperplasia of the foetal thyroid but this can be counteracted by giving thyroxine at the same time. A foetal goitre so produced usually decreases within the first three months of extra-uterine life.

Analgesic drugs. It is necessary, when administering certain drugs to the mother either in pregnancy or in labour, to consider the possible effects which they may have upon the foetus. In this respect the properties of most of the sedatives and anaesthetics are well known to clinicians. The foetus for example is very sensitive to morphine and its derivatives and the respiratory centre may be depressed thereby for many hours after administration to the mother, particularly in premature labour. Fortunately, nalorphine is an antagonist to the respiratory depressant effects of morphine, pethidine and drugs of this class. The barbiturates have an even more persistent effect upon the baby and their effects cannot be so readily reversed. The placenta is likewise no respecter of anaesthetics and as a general rule the depression of a baby's vital centres is directly proportional to the degree of general anaesthesia induced in the mother.

Hypotensive agents. Less obvious perhaps are the effects on the foetus of certain drugs given to the mother during pregnancy and before labour, and it has to be remembered that the placenta acts less as a selective filter than as an undiscriminating means of transfer. For example, a variety of hypotensive agents, given to reduce maternal blood pressure in such conditions as pre-eclamptic toxaemia, may reach the foetus in steadily increasing concentration. Hexamethonium was one of the first of these to be so used and was shown by Young (1953) to reach a concentration in the liquor amnii exceeding that of the maternal blood within four hours, taking from twenty-four to thirty-six hours to disappear, thus indicating the possibility of a two-way traffic across the placenta. Babies whose birth coincides with this period of drug absorption and retention may succumb to ileus, and it is obvious that the placental transference of any such substance and its persistence in the foetus must be carefully evaluated before its use can be sanctioned.

Dicoumarol. As another instance, drugs of the dicoumarol class can also cross the placenta and in large doses may be very toxic to the foetus, causing liver damage and a foetal haemorrhagic diathesis. With normal and controlled therapeutic dosage, however, one should not be afraid to treat antenatal thrombosis in the mother with drugs of this class.

Transmission of Disease and Immunity during Prenatal Life

A variety of antigens and infecting agents may cross from mother to foetus, either through an intact placenta or where the placental barrier has first been damaged. In the case of micro-organisms, as distinct from viruses, for example those of syphilis, tuberculosis and malaria, the placenta must first be affected, so that the term 'placental barrier' is not wholly inappropriate. Viruses, on the other hand, traverse the intact placenta very easily so that babies may be born with the manifestations of an active infection. Much will depend, of course, upon the availability of the virus; for example, the writer has encountered two cases of active and acute poliomyelitis complicating labour, yet, in neither instance was the baby affected, presumably because the virus is quickly fixed in the maternal central nervous system in preference to overflowing across the placenta into the foetus. On the other hand measles and mumps can occur at or very shortly after birth.

Any active immunity which the mother has developed is automatically acquired passively by the baby since the placenta allows the transference of antibodies. In man passive immunity is thus acquired before birth, though in many animals it is mainly acquired after birth through the medium of ingested colostrum (Brambell, Hemmings and Henderson, 1951).

There would appear, however, to be some selection of the antibodies crossing the placenta, both qualitative and quantitative and, as an instance of this, it is to be noted that whereas the blocking or incomplete antibodies to the Rh factor cross the placenta to the detriment of the Rh positive child, the complete antibodies usually do not. Antibodies to the following cross easily: Measles, smallpox, chicken pox, mumps, poliomyelitis, influenza, tetanus and diphtheria. The resultant passive immunity may last for several months, according to the nature of the infection, but in all cases it has usually sagged to ineffectual levels after about six months.

According to Brambell, Hemmings and Henderson, the human foetal gamma-globulin level of the cord blood may exceed that of the maternal blood and antibody titre may also be higher, but different antibodies are acquired at different levels. A late pregnancy fall in the gamma-globulin level in maternal serum has been noted, by electrophoresis, by Brown (1954) to accompany a rise in the alpha- and beta-globulin levels, thus showing that the fall could not be attributed to the physiological haemodilution of pregnancy. It is therefore suggested that the late fall in the gamma-globulin level might be associated with the transfer of immunity to the foetus. Intrauterine immunity mechanisms in foetal life differ from the inflammatory responses of antibody formation which occur after birth. The foetus learns *in utero* to accept potentially antigenic proteins, including those of its own tissues, without producing a hostile response. Failure of this latter mechanism may be responsible for the development of auto-immune disease in later life.

Obstetrical Complications and Prenatal Development

Considering the number of conditions to which the flesh of the pregnant woman is heir, it is surprising how well protected the foetus remains *in utero* and, provided it escapes intrauterine death, how rarely its development is retarded or set awry by obstetrical complications. Certain maternal conditions, of course, kill it outright, for example any acute febrile illness of the mother associated with hyperpyrexia, serious degrees of abruptio of the placenta, also profound maternal asphyxia, as, for instance, in unfortunately administered anaesthesia. Even traumatic accidents to the mother have to be gross in order to affect the child in its well cushioned intra-amniotic existence. Certain conditions, however, commonly interrupt the comfortable and undisturbed life of the foetus by favouring the onset of premature labour, including severe degrees of cardiac disability, renal deficiencies, hydramnios, large fibroids and malnutrition, to say nothing of the therapeutic termination of pregnancy undertaken for a variety of conditions in purely maternal interests. Development, however, is more often abnormal in uniovular twins and in foetuses of elderly primigravidae, the latter being particularly liable to mongolism (see Chapter 1). In placenta praevia Macafee has shown a 3·4 per cent incidence of foetal abnormality.

Of all the general diseases of the mother, diabetes mellitus is one of the most important and interesting in its effects upon the foetus. Of the babies perishing, about one-third die *in utero* and more than half succumb in the neonatal period. The pregnant diabetic patient is also liable to suffer the additional risks of pre-eclamptic toxaemia and coma and in many of the cases there are sound indications for the premature induction of labour, or the performance of elective Caesarean section before the thirty-seventh week of pregnancy. It takes a nicely balanced judgment to decide between the mounting risks of intrauterine death if pregnancy is allowed to continue too long and the greater risks of neonatal death from prematurity if intervention is undertaken too soon. Added to all this the incidence of foetal abnormality in diabetic pregnancy is higher than normal.

The baby's blood-sugar before birth inevitably reflects, to some extent, the level in the maternal blood whereas, after birth, there is an abrupt fall to the usual low neonatal level. The sharp change may well tax the child's endurance and metabolic resources overwhelmingly although it usually comes to better terms with its new blood-sugar within a day or two.

Hydramnios is also associated with defects in foetal development but this is more often an effect than a cause as, for example, in anencephaly and oesophageal atresia where riddance of excessive quantities of liquor amnii cannot be achieved by swallowing and ingestion. To exclude the latter at birth it is now routine practice to pass an oesophageal catheter in all cases of hydramnios. Oligohydramnios, on the other hand, may mechanically restrict the normal development of the limbs, particularly the feet.

Our knowledge of factors during intrauterine life which may handicap the subsequent development of the child is not as great as it is of actual perinatal mortality, especially since the massive nation-wide survey undertaken by the National Birthday Trust (Butler and Bonham, 1963) and there is a natural tendency to extrapolate from the causes of perinatal death to subsequent handicap in the surviving child, which may be misleading. When one comes to consider the causes of handicap it is necessary to look further afield than merely obstetrical causes and Sheridan (1962) divides babies at risk of handicap into five main groups:

1. Background group—family and social history.
2. Prenatal—disorders of early and late pregnancy.
3. Perinatal group, whether premature or not.
4. Postnatal.
5. Symptomatic group in which mental or physical retardation or some major defect comes to light in childhood.

The obstetrician is therefore only concerned with Groups 2 and 3, and these factors are tabulated in the following Table 5.

TABLE 5

Unfavourable Factors

- Prematurity
- Hypertension
- Rh. with antibodies
- Acute infections
- A.P.H. of any variety
- Postmaturity—over 42 weeks
- Diabetes and thyrotoxicosis
- Threatened abortion
- Twins and hydramnios
- Difficulties in labour
  - Malpresentation
  - Forceps and caesarean section
  - Foetal distress

Often obstetrical factors are superimposed upon bad social and genetic antecedents and Drillien (1964), for example, considered that it was unlikely that obstetric complications, apart from prematurity could account for the mental retardation or neurological disorder in many of the cases which she considered, but she thought that an obstetrical complication might constitute an added insult to an already damaged central nervous system.

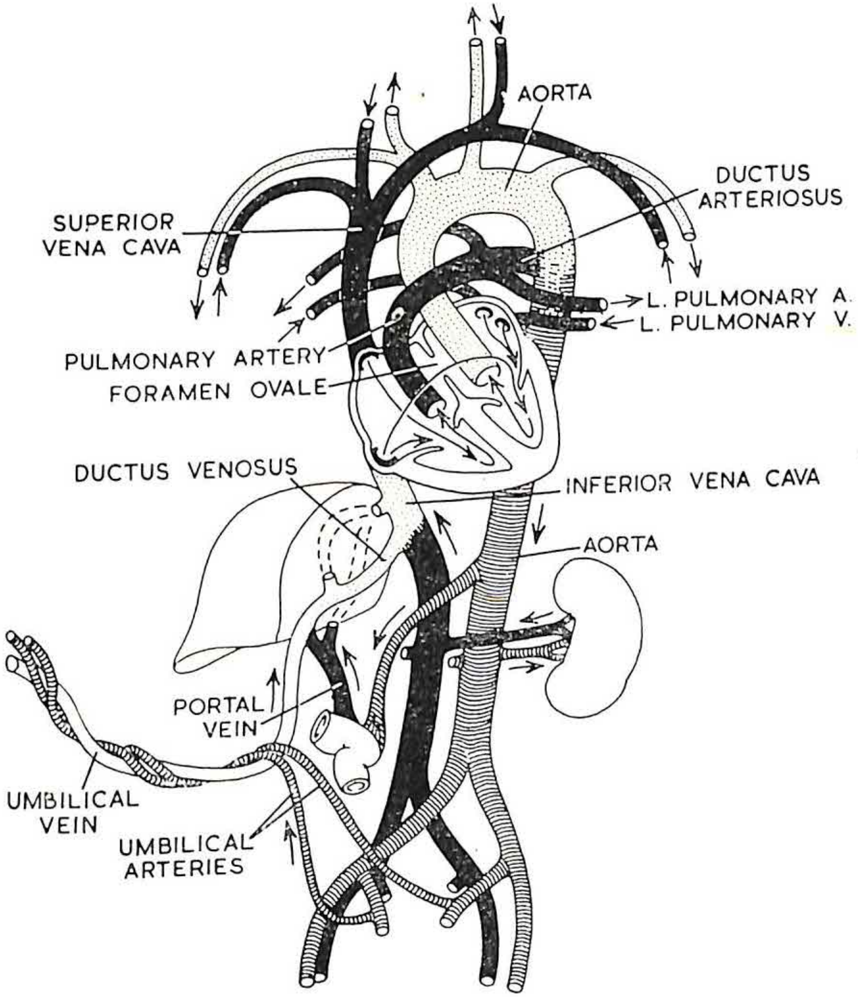
When dealing with the subject of neonatal hyperbilirubinaemia, whether from haemolytic disease or prematurity, it is likewise uncertain to what extent high serum bilirubin alone may be responsible for damaging intellectual development, and Illingworth (1963), doubted if this factor operated unless associated with the full picture of Kernicterus.

It will thus be seen from these examples that the modern study of the influences which may interfere with prenatal development now ranges far and wide on an ever-increasing scale.

Foetal Circulation

The accompanying diagram (Fig. 5) illustrates the ingenious mechanism whereby the foetus not only receives its oxygen and nourishment and gets rid of its waste products through the placenta, but can adapt itself with a minimum number of alterations to extra-uterine life.

Oxygenated blood coming from the placenta via the umbilical vein travels by the ductus venosus to the inferior vena cava and some of it filters through the liver to mingle with the circulation supplied to this organ through the hepatic arteries and the portal vein. From the inferior vena cava it reaches the right atrium. Three-quarters of this blood is thereupon diverted through the foramen ovale into the left side of the heart and only a quarter proceeds into the right ventricle. The blood which traverses the foramen ovale enters the left atrium and is passed into the left ventricle from which, still retaining most of its oxygen supply from the placenta, it is pumped directly to the head and neck and upper extremities. The blood returning from the head enters the right atrium via the superior vena cava and is passed straight on into the right ventricle, there to mingle with the fraction coming from the inferior vena cava. Both ventricles pump equally. A small quantity of the blood from the right ventricle, containing an even smaller quantity of oxygenated blood from the inferior vena cava, goes to the lungs via the pulmonary arteries, but the majority is shunted from the pulmonary system through the ductus arteriosus into the aorta distal to the vessels supplying the head and neck and upper extremities. This blood has lost most of its oxygen and, although a certain amount goes to the lower trunk and lower extremities, the majority is pumped down the umbilical arteries to the placenta. It will be seen therefore that the brain and liver get the best of the available supplies of oxygenated blood.



NORMAL CIRCULATION IN THE FOETUS

FIG. 5. The normal circulation in the foetus. Vessels containing blood with high oxygen saturation are shown white; stippled, shaded and black areas indicate decreasing degrees of oxygen saturation. (Redrawn from *Seminar Int.*, 1953, 8.)

Circulatory Changes at Birth

There is a short-lived but transitional circulatory state at birth before the pattern of extra-uterine circulation is finally adopted. This depends upon the speed and efficacy with which respiration is established. The work of Dawes and his team has indicated that, in the first place, lung inflation with a gas, whether spontaneous or artificial, lowers pulmonary vascular resistance and increases the blood flow through the lungs.

Jaykka (1958) postulated that the resulting distension of the lung capillaries erected the walls of the crumpled sac-like alveoli and he noted that the capillary bed is not opened up in areas of atelectatic lungs. Furthermore he regards a patent capillary bed as synonymous with capillary erection and a prerequisite of normal lung expansion. Although it is unlikely that this, in itself, causes very appreciable aeration it almost certainly facilitates it.

The increased blood flow returning from the lungs raises the pressure within the left atrium and reverses the gradient across the foramen ovale which now closes. At the same time the pulmonary demands encourage a temporary left to right shunt through the ductus arteriosus, that is to say in the opposite direction to the shunt during intrauterine life.

By this mechanism it will be seen that some of the blood returning from the lungs via the left atrium is now pumped by the left ventricle through the ductus and back into the lungs for a second helping of oxygen. As long as the lungs are atelectatic and therefore inefficient oxygenating organs this ingenious mechanism helps to accelerate the rise in percentage oxygen saturation of the blood until the level rises from 60 per cent at birth to over 90 per cent at which level the walls of the ductus contract and cause functional closure. This is achieved within the first hour or two in normal cases (Dawes *et al.*, 1953, 1954).

Now in cases of asphyxia this mechanism persists and has been shown by Lind and Wegelius (1954) to come into operation again should respiratory difficulty or asphyxia recur and the foramen ovale and ductus reopen, but when pulmonary resistances are high, as they are believed to be in some kinds of respiratory difficulty, blood which should have gone to the lungs is now shunted from right to left through the ductus into the aorta as in intrauterine existence. A vicious circle is set up, less blood returns to the left atrium which suffers a pressure drop and the foramen ovale reopens. This is believed to be one of the mechanisms in 'blue' or cyanotic attacks after birth.

It will be seen then that the initiation of respiration is of paramount importance in bringing about the neonatal circulatory readjustments and no important circulatory changes have been observed before the first breath (Jaykka).

Where asphyxia complicates the birth process Mott (1961) has shown that survival depends on the stores of glycogen within the heart muscle of the foetus. Foetal brain does not store glycogen to any extent and it depends upon glucose for its metabolism which may under certain circumstances be largely anaerobic. This glucose has to be efficiently circulated to the brain and this in its turn will depend upon efficient cardiac activity. One of the worst signs in neonatal asphyxia is a slowness and irregularity and feebleness of the cardiac impulse and glycogen metabolism would appear to play a very dominant role in maintaining cardiac activity. The liver stores of glycogen have been shown by Shelley (1961) to increase very rapidly towards term, but these stores are rapidly depleted in the presence of hypoxia, and Stafford and Weatherall (1960) have indicated that it may take many hours to replace them after they have been thus depleted. Chronic hypoxic conditions are therefore more dangerous than acute episodes, as often occur late in the second stage of labour and from which recovery is equally rapid whatever the method of resuscitation employed. This may explain the treacherous ease with which some babies die *in utero* sometimes before the stresses of labour have had a chance to exert themselves in conditions known to interfere with intrauterine oxygenation.

The asphyxiated baby can achieve a remarkable degree of survival for a time on anaerobic glycolysis. When oxygen supplies are deficient there is a rise as a result of this mechanism in the ratio of reduced to oxidised nicotinamide adenosine dinucleotide (NAD) and it would appear that the ratio of lactate to pyruvate in the blood which is determined by the lactate dehydrogenase system (LDH) working within the cells (Derom, 1964), is directly related likewise and that this lactate/pyruvate ratio is the same in tissue cells and blood because of ready diffusion. When this ratio is significantly increased due to excess lactate a measure of the degree of anaerobic glycolysis taking place is furnished. Derom studied these ratios in relation to the foetus at birth. These tests must be done immediately the blood samples from the foetus are collected and analysis consists of an enzymatic method using lactic dehydrogenase and spectrophotometry. A study of this ratio has shown that labour increases both the lactate and pyruvate levels within the mother and, as in muscular exercise the lactate increase predominates, but Derom showed by comparison with the ratio in foetal blood that the foetus, at least in normal labour, did not in itself produce excess lactate by having to resort to anaerobic metabolism; in fact any excess lactate in a baby following a normal delivery simply reflects the state within the mother. The baby, however, at birth must now metabolise the excess lactate itself by acquiring oxygen by hyperventilation. What is still to be worked out, however, is the degree to which this ratio may reflect the degree of genuine foetal distress in difficult or prolonged labour and, in fact, blood samples can be taken long before delivery by puncture of the foetal scalp through a speculum. The estimation however is still too laborious to influence a decision on the conduct of labour which must still be made on so-called clinical grounds. All babies, in fact, are born with a metabolic acidosis to which may be superadded a respiratory acidosis, the elimination of both of which depends upon the adequate initiation of respiration.

Intrauterine Preparation for Respiration

The functional development of the central nervous system proceeds from below upwards, starting at the lower part of the medulla. It is incorrect to think of the respiratory centre as an anatomical point which can be picked off, for example, 'by piqure', in fact, it extends longitudinally in the hind-brain. Barcroft has shown that the lowest part of this centre, which develops first, has a very crude respiratory function and can initiate only gasping movements which he was able to demonstrate in early sheep foetuses. As the respiratory centre develops, however, its function becomes more refined and now a respiratory rhythm can be evoked, though the movements are associated with other somatic muscular movements, for example of the head and neck. As the development of this centre proceeds higher still, the respiratory rhythmical movements become separated from associated and irrelevant somatic muscular movements. Both the last two mentioned types of respiratory activity can be initiated by sensory stimuli. As development proceeds still further the highest portion of the respiratory centre comes into play, whose effect is one of inhibition, so that respiratory movements can only be initiated by severe stimuli including those of asphyxia.

Prolonged respiratory activity *in utero* is pointless and it will therefore be seen that in later pregnancy the foetus, thanks to the inhibitory effect of the highest part of the respiratory centre, will not continually engage in respiratory movements except from time to time in response to appropriate stimuli. Before the onset of labour, these stimuli are most likely to be chemical, but, after labour starts sensory stimuli also begin to operate. The baby therefore is progressively woken up during normal labour to start breathing. Obviously prolonged labour, with, for example infected liquor and mounting asphyxia, will encourage deep inspiratory movements before birth, so that in these unfortunate cases, the child may be born with an already established pneumonia contracted intranatally.

The existence of respiratory activity from time to time before birth is no longer questioned and Potter has cited experiments in which thorotrast was injected into the amniotic cavity, at periods ranging from forty-eight hours to fifteen minutes before birth. Radiographs then demonstrated higher concentrations of thorotrast in the lungs than in the liquor, the relative difference being greater the longer the interval before delivery, suggesting that the dye was concentrated within the lungs by the absorption of fluid.

The presence of liquor amnii within the lungs at birth is physiological, but the amount is normally not great and, under these circumstances, it is in no way harmful since it is very rapidly absorbed, provided always that the pulmonary circulation at birth is efficiently established. In cases of prematurity and foetal shock (white asphyxia) this very necessary proviso may not obtain; in fact, a stagnant pulmonary circulation may account for much of the respiratory difficulty which is sometimes encountered in such neonates.

The development of the pulmonary system has been described by Potter as follows. It begins as an anterior projection in the upper part of the endodermal canal, communicating at first with what will later be the oesophagus. This projection branches downwards to the right and the left, dividing further into two left and three right branches. The larynx, trachea and bronchi are thus originated. Thereafter progressive, further branching takes place. The original projection is surrounded by mesenchyme which, in its further proliferation, spreads on to the branching bronchiolar system. The mesenchyme carries the blood vessels and supplies the connective tissue which progressively decreases as maturity advances. Meanwhile the vascular system develops apace and comes into increasingly intimate contact with the new alveolar structures.

Alveolar development is already taking place at the twenty-second week and, early on, a few capillaries are to be found adjacent to the alveolar spaces, although a cuboidal epithelium predominates in most areas. By term, however, all cuboidal lining of the alveoli and ducts has disappeared. Barnard and Day (1937) have pointed out that in birds' lungs the walls of the capillaries themselves form the alveolar margins and are consequently in direct contact with the air contained therein, and they deny the existence of epithelial lining of the alveoli in mature humans. From a study of foetuses at varying stages of gestation they concluded that the epithelial lining of alveoli begins to disappear towards the end of the fifth month and does not thereafter reappear. The suggestion is therefore that, prior to this period, alveolar ventilation is not possible.

Establishment of Respiration at Birth

Five necessary conditions must be present for respiration to become satisfactorily established:

1. A functionally active and competent respiratory centre.
2. A clear airway.
3. Adequate respiratory movements.
4. A suitable atmosphere.
5. An adequate circulation to the vital centres.

A baby's arrival into this world must come as a rude sensory shock. At once, afferent stimuli from the skin and joints, reinforced by mild hypoxia, crowd in upon the child's central nervous system. The carotid sinus, too, reacts as a receptor organ to both chemical as well as pressor stimuli and is sensitive to rising carbon dioxide concentrations. Provided therefore that the respiratory centre is not already damaged or depressed, it is bound to react. The baby that has even half a chance to breathe at birth will usually take it, and it is very doubtful if immaturity of the respiratory centre is in itself responsible for failure to breathe after birth (Potter).

The activity of the respiratory centre may, of course, be depressed by antecedent anoxia during labour, howsoever caused, by raised intracranial pressure including intracranial bleeding and by the persistent action of narcotic and analgesic drugs given to the mother.

The inhibition of respiratory centre activity, which has developed in later pregnancy, is removed at birth by the magnitude of the sensory and chemical stimuli which reach it. If, on the other hand, this centre is depressed at birth, it takes more than sensory stimuli to start rhythmical breathing and mounting asphyxia evokes a more primitive type of respiratory activity, for example, the gasp. If, now, the baby is lucky enough to absorb enough oxygen with such a gasp it is possible that the rhythm controlling centre may be revived. The chemoreceptors within the carotid sinus play a part in initiating gasps when the respiratory centre itself is severely handicapped provided that the sinus itself is not too severely depressed.

Asphyxia mounts with lengthening delay in establishing respiration, so that the very centres called upon to initiate breathing become less and less capable of doing so. A vicious circle is consequently set up and before long the damage becomes irreversible and death ensues. Animal foetuses can withstand complete oxygen starvation for about ten times as long as adult animals. The safety margin is not so large in the human, but it is nevertheless considerable and periods up to ten minutes are compatible with recovery, although the extent to which the higher intellectual centres of the brain may be damaged has not yet been determined. The ability of the foetus to withstand anoxia at birth diminishes within the first day or two. This fact possibly may be explained by a type of anaerobic energy together with a low metabolic rate of the foetal central nervous system at birth.

With regard to the remainder of the conditions which must be necessary at birth in order to establish respiration, the patency of the air passages is too obvious to need further comment. Respiratory movements may be inadequate to ventilate the lungs in the child suffering from severe foetal shock or prematurity. In the latter instance, the softness of the thoracic cage often provides insufficient mechanical purchase for the action of the diaphragm so that, in atelectasis, the well-known clinical signs of recession of the chest wall can be observed in the child's unrewarding attempts to overcome the moist cohesion of its alveolar walls and the internal resistances of the lung structure.

The lungs can only be opened up by the exercise of negative intrathoracic pressure. Initially these pressures are very great and, using a method of intra-oesophageal pressure electromanometry pressure swings up to 90 cm. of water of which the purely negative component commonly exceeded 40 cm. of water have been recorded (Donald *et al.*, 1958). In fact no appreciable lung inflation is regarded as possible with anything less than a negative intrathoracic pressure of 20 to 40 cm. of water (Karlberg, 1960). This is indeed a great effort and compares with the maximum inspiratory effort of which an adult, according to Smith, is capable, namely 95 cm. of water. It will be seen therefore how difficult it must be for the premature, narcotised, or shocked infant to achieve a flying start to respiration.

The rapidity with which the alveoli may open up and the lungs expand is inversely proportional to the degree of prematurity. Nevertheless, radiographic studies of the lungs have shown that, even in quite severe degrees of prematurity, a satisfactory state of aeration can be demonstrated, at least radiologically, within the first two hours of life (Donald and Steiner, 1953), although it is probable that, in these cases, histological evidence of full aeration will not be achieved for several days.

The functional reserve of the lungs is very great and it is surprising to note on how little functioning lung-tissue the newborn can, for a time, survive. The effort, however, of trying to maintain respiration in the face of the gross mechanical handicap of atelectasis may ultimately prove too much for the child's powers of endurance so that recurrent bouts of peripheral circulatory failure with cessation of respiration (cyanotic attacks) may close the short chapter of the child's life.

In any case, whether handicapped by prematurity or not, pulmonary expansion requires the exercise of considerable pressure, but once the alveoli have expanded very much lower pressures are required to keep them open. A two-phase expansion of the lungs has been described by Day and his colleagues (1952) who have shown that there is, initially, an abrupt expansion followed by a more gradual increase as the inflating pressure is maintained and they consider that these initial, high pressures can only operate safely for short periods, intermittently, of not more than 0·15 seconds. However, any alveolar expansion so obtained can immediately thereafter be enhanced by the maintenance of a lower pressure. These experiments were performed on animal lungs but the results would appear to have some practical bearing on the present day haphazard methods of trying to assist pulmonary inflation by artificial means.

The measurement of intrathoracic pressures upon which the writer, amongst others, has been engaged serves to indicate two things, firstly, the vigour with which the child is trying to expand its lungs and, secondly, a measure of its great need in this respect. Once the lungs have expanded these fierce pressure swings are no longer necessary. On the other hand the child who is centrally depressed may never make much of an effort from the start. It has also been noted by Karlberg *et al.* (1954) that the sick infant, suffering from respiratory distress, requires to exert itself two to five times as greatly as the normal child.

The simultaneous recording of intrathoracic pressures, as an index of respiratory effort, and the tidal airs produced, as an index of respiratory achievement has been investigated by the writer. In the normal case, and within certain limits, effort is matched by achievement so that a large effort, rewarded with only a small tidal air, would appear to indicate some mechanical difficulty operating between the level of glottis and alveolus. The disparity may thus give some indication of the degree of atelectasis. We have shown in our experiments the diminishing ratio of oesophageal pressures to tidal air measurements as pulmonary expansion increases. Even in respiratory distress, however, Karlberg *et al.* find that an adequate ventilating minute volume can be reached by an increase in the respiratory rate and can thus achieve a normal carbon dioxide elimination and oxygen consumption, but this is at the cost of harder work on the part of the infant. They go on to state that tidal volumes may be normal in respiratory distress but the ratio of functional dead space to tidal volume is higher.

The parts of the lungs which are most quickly opened up are the anterior margins of the lobes and the right middle lobe, because there is less thickness of intervening pulmonary tissue between the surfaces here exposed to the action of negative pressures. These observations have been made by necropsy study but Karlberg by ciné-radiography found that the lower posterior parts of the lungs were aerated first. In the normal case, the entire lung expands very rapidly, certainly within a matter of minutes or hours, but, where expansion has been abnormal, for example in premature infants or following 'effective methods' of artificial respiration, Potter has noted at necropsy that the proximal portions and the alveolar ducts are overdistended, often at the expense of surrounding alveoli. This too has been our experience.

The lungs may either fail to expand from the very first or may collapse secondarily, a condition referred to by Morison (1963) as 'secondary resorption non-aeration'. There is abundant evidence of the truth of this statement and the writer has frequently observed totally collapsed lungs at necropsy although some degree of aeration was radiologically demonstrable during life and measurements of tidal air and minute volume had been obtained. It is impossible to tell, from histological examination, the difference between alveoli which are primarily atelectatic and those secondarily so.

The description of hyaline membrane atelectasis would be out of place here as it does not concern prenatal development. Suffice it to say that a few hours of respiratory effort after birth is a necessary prerequisite for its development.

The lungs, particularly those affected by atelectasis, show evidence of acute infection more often than any other organ at birth. It is reasonable to suppose that this infection gains access by the upper air passages, for example, from the inhalation of infected liquor amnii rather than through the cord blood, since otherwise the liver would be the first organ to show such evidences.

To establish respiration is one thing but to maintain it is another and, particularly in the case of the premature infant, failure in the second respect is common. The differential diagnosis with which the clinician may then be faced is formidable indeed.

Nowadays no one should be content with an unqualified opinion that a perinatal death has been due to prematurity, atelectasis or asphyxia. A sufficiently detailed necropsy will, in the majority of cases, reveal the mechanism by which the child died. Until the detailed pathology with which the clinician is faced is more widely looked into and appreciated, we cannot hope for a more rational treatment of respiratory difficulties at birth and a consequent reduction in the loss of human life from such causes which, in numerical importance, rival any of the hazards of later childhood.

IAN DONALD

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Chapter 3

THE NEWBORN

BIRTH normally occurs when foetal development, with all its intricate anatomical and biochemical inter-relationships, reaches a point at which the extra-uterine environment offers significant advantages. At a gestational age of about forty weeks the baby is a unique mixture of helplessness and capacity for survival. The transformation from the life of an aquatic parasite to separate existence in air is dramatic and it is accompanied by radical and sudden changes in every system and in the physiological relationships between systems. Survival and health depend upon their successful establishment. Truly independent living, of course, is achieved only gradually over the years to maturity, and in the newborn period the infant's susceptibility to such common dangers as chilling, starvation, dehydration, assault and infection place him entirely at the mercy of those entrusted with his care. Yet in spite of this frailty he can survive, undamaged, a degree of oxygen lack which would prove lethal to an athlete, while he can withstand major illnesses and surgery in a way which belies his appearance.

The period during which an infant is regarded for statistical purposes as 'newborn' is the first month after birth, and deaths during this time are classified as neonatal deaths. (Some authors in referring to the neonatal period, however, confine themselves to the first fourteen days of life or to the lying-in period, particularly when considering 'perinatal' mortality, *i.e.* the combined foetal wastage from stillbirth and deaths during the early neonatal period.)

Whilst we are concerned here primarily with normal development rather than with mortality and morbidity, an appreciation of the physiology of the normal newborn infant is essential if deviations from the normal are to be recognised early and adequately treated. The purpose of this chapter is to provide an outline of current knowledge upon which his care can be based.

Respiration. The pre-natal preparations for respiration, its control, the resistance of unexpanded lung tissue and the cohesion of the foetal lung surfaces, along with the forces available to overcome them, have been considered already. Recent ciné-roentgen studies have shown how thoracic compression at birth helps to clear the airway in preparation for the first breath. Should effective respiration begin at once, then lung expansion may be achieved within several respirations, but between this sort of onset and neonatal asphyxia there are such gentler beginnings as may be evidenced only by small excursions of the alae nasi or abdominal wall, by subtle improvement in colour or by swallowing movements. The latter, described as frog breathing (Bosma *et al.*, 1959), may serve to increase pressure within the airway and this may reflexly stimulate the inspiratory effort (Marshall and Widdicombe, 1958; Dawes, 1961).

At this age, when hazardous transfer to lung breathing must be made, the baby is suitably resistant to anoxia. Although this may result in part from the possession of some form of anaerobic metabolism, the relative simplicity of immature tissue may be associated with reduced demand for oxygen and substrate. Survival, however, is dependent upon circulation, and this in turn involves the adequacy of cardiac glycogen (Shelley, 1964). Survival times in experimental animals may be increased by maintaining plasma pH and by giving glucose, although neither treatment is effective alone (Dawes, Mott and Stafford, 1960). Under clinical conditions the duration of anoxia before or after birth and its degree are often unknown. Survival for fifteen minutes, apnoeic but with an active circulation, has been suggested as approaching the limit of survival, but the integrity of the central nervous system is likelier to suffer directly with the duration of severe oxygen lack. The severity of anoxic effects has been expressed as a score (0—10) by Apgar (1953) who allots points to the heart-rate, respiration, colour, muscle tone and reflex irritability of babies one minute after delivery. The technique is simple and the result is a helpful indication not only of the need for resuscitation but it may correlate with the long-term prognosis.

Resuscitative measures are necessary in a small proportion of babies only and should have a physiological basis. Thus a clear nasal and laryngotracheobronchial airway is a prerequisite of success, and care should be taken to maintain body heat although cooling has been employed under both experimental and clinical conditions (Miller *et al.*, 1964). Positive pressure, intermittently applied to mimic respiration and within the pressure limits attainable by the newborn, is the most effective measure and is best carried out by intubation or, rather less effectively, by a mask, while cautious mouth-to-mouth breathing may be life-saving in dire emergency. The giving of oxygen into the stomach is probably much less effective than was previously thought (Nelson, 1960; Coxon, 1960; Cooper *et al.*, 1960) and has been abandoned. Trials of hyperbaric oxygen are being followed with interest (Hutchison *et al.*, 1963). Established respiration has a normal frequency of 25 to 50 each minute but may be irregular in rhythm or punctuated by short periods of apnoea. Although these irregularities may be corrected by giving oxygen, this need not be done if the infant appears to be well otherwise. Scattered moist sounds may be heard throughout the chest during the first few hours but otherwise the careful examination of the chest yields the normal or abnormal physical findings of infancy. Some degree of costal recession is permissible in babies of low birth weight.

Circulation. The major circulatory readjustments which accompany the change from intrauterine to extra-uterine life continue to be the object of much investigation. The umbilical arteries usually cease pulsating within five minutes, but in some infants pulsation continues considerably longer, and along with a very high umbilical venous pressure it may persist for hours in the presence of even moderate degrees of respiratory distress, so that release of cord occlusion may be accompanied by profuse bleeding (Desmond *et al.*, 1959). The relationship of the umbilical arteries to those supplying the sciatic nerves should be remembered, as the accidental injection of such materials as coramine into the former may result in sciatic paralysis and sometimes cutaneous gangrene of the ipselateral buttock (Hudson *et al.*, 1950). Although the umbilical vein usually remains functionally patent for some minutes only in order to permit drainage from the placenta, it can be catheterised without difficulty during the first week and is therefore available for late exchange transfusion in such conditions as hyperbilirubinaemia. The ductus venosus is presumed to close functionally within a few minutes of birth, but it too may be successfully catheterised from the umbilicus and it is probably wise to avoid doing so during exchange transfusion as otherwise the tip of the catheter comes to lie near or in the right side of the heart with possibly harmful results.

With termination of the placental circulation a sharp rise occurs in peripheral resistance and simultaneously expansion of the lungs increases their vascular bed so that pulmonary resistance falls. The resulting increased pressure in the left heart and decreased pressure in the right cause functional closure of the flap valve covering the foramen ovale, and any subsequent shunt through it in the normal human newborn is thought to be very small. Functional closure of the ductus arteriosus, however, may be delayed for some time. At least some of those cardiac murmurs which can frequently be detected soon after birth have been attributed by Burnard (1958) to deferred closure but could be caused by mitral regurgitation secondary to asphyxia and cardiac dilatation (Burnard, 1963). A right to left shunt has been demonstrated during the first hour (James, 1961) but thereafter the evidence favours a flow from left to right (Adams and Lind, 1957; James and Rowe, 1957; Jegier *et al.*, 1964). Shunting through the foramen ovale is confined to the first 24 hours (James and Burnard, 1961). The balance of pressure within the ductus is likely to be delicate during the first few hours, but evidence of shunting through it may be detected up to one week after birth (Jegier *et al.*, 1964). Closure may be favoured by oxygen and pressor amines and opposed by hypoxia. The frequency with which cardiac murmurs are recorded at this age depends upon the skill of the observer and the frequency of auscultation, but only the minority persist and are associated with congenital heart disease, whereas some severe malformations are quite unassociated with neonatal cardiac murmurs (Benson *et al.*, 1961).

The heart is relatively large at birth and a greatest permissible transverse diameter on X-ray of 5·7 cm. is a preferable measurement of size than is the cardio-thoracic ratio (Smith, 1959). The size varies somewhat in the first few hours, particularly in the presence of respiratory distress (Burnard, 1959) or of changes in blood volume (Wallgren *et al.*, 1964), and may do so for some days, but progressive disproportionate increase during the newborn period generally indicates a malformation. The normal heart rate varies quite widely but tends to stabilise between 120 and 130 each minute after the first few hours when it may be a little higher. The electrocardiographic pattern in the first few months of life shows right ventricular preponderance; occasional extra systoles or variability of the T waves need not be abnormal.

The practical value of recording the blood pressure of the newborn has lain in the diagnosis of aortic coarctation. Recent studies, however, have called attention to variations in individual blood pressure readings during the first few hours and days and possibly significant differences in the mean blood pressures of certain groups. Thus Ashworth and Neligan (1959) found that the systolic blood pressure at birth ranged from 62 to 116 mm. of mercury and that it fell to 44 to 74 mm. in a few hours if the umbilical cord were clamped early, or rather later if clamping had been delayed. It then rose during the second day and slowly throughout the first week. Lower means were recorded in infants suffering from respiratory distress syndrome and in those who were delivered by Caesarean section. The simple and effective sphygmomanometer designed by Ashworth, Neligan and Rogers (1959) occludes the brachial artery by means of a 2·5 cm. cuff. On gradually releasing this the return of radial pulsation is picked up by a second cuff which indicates the point by transmitting the wave to a drop of xylol in a capillary column. More recently a 4 cm. cuff has been gaining in popularity (Young, 1961).

Deferred clamping of the umbilical cord and lowering of the baby below the level of the uterus assures him of a considerable placental transfusion (De Marsh *et al.*, 1942; Gunther, 1957), especially if the cord is uninterrupted until after respiration has begun (Redmond *et al.*, 1965). The possible advantages of this to the baby remain doubtful. Any effect on haematocrit and well-being may be brief (Selander, 1944), and Lanzkowsky (1960) has confirmed that although the haemoglobin is significantly higher during the first three days in infants whose cords have been clamped late, this is no longer demonstrable at the age of three months. Spontaneous variations in blood volume and haematocrit may occur in individual newborn infants during the first few hours, but quite contrary findings have been reported by Gairdner *et al.* (1958) and Sisson and Whalen (1960). The former attributed decreased blood volume and increased haematocrit to loss of protein, water and salts from the vascular compartment, while Sisson and Whalen suggest that an increased volume results from the post-natal release of blood temporarily sequestrated in reservoirs.

Vasomotor tone exists from birth, although immaturity of control may explain the harlequin colour changes (Neligan and Strang, 1952) which may sometimes be seen in newborn infants, particularly if they are premature. The attacks are of short duration and are characterised by a striking difference in the colour of the two longitudinal halves of the body. They occur mostly on the third and fourth days of life. Peripheral stagnation and cyanosis are common on the first day and should not be misinterpreted as necessarily implying congenital heart disease. The capillary network of the newborn infant is less well developed than that of the adult (Arajärvi, 1953). Capillary resistance is low at birth (Walker and Balf, 1954) and increases over the first week. Premature infants have a lower initial capillary resistance but it increases from birth in the same way and even among full-term babies the resistance increases with birth weight. The authors found no variation with sex or season, and the capillary resistance appears to be uninfluenced by the mode of delivery, the giving of vitamin K, or the presence or absence of jaundice. They concluded that the maturity of the capillary bed at birth is of primary importance in determining capillary resistance. This decreasing resistance with immaturity may explain the greater permeability of the small blood vessels of newborn babies, as a result of which water, salts and protein can escape more readily from the vascular compartment, so causing the firm oedema which may develop after birth in certain circumstances.

Idiopathic respiratory distress syndrome. Because the pulmonary hyaline membrane associated with respiratory distress is responsible for at least half the deaths occurring among prematurely born babies, this syndrome, which is fully described in most textbooks of paediatrics or obstetrics, is currently the object of intensive research. Although the aetiology remains obscure it seems to involve immaturity in one or more systems and to be closely linked with some still unrecognised prenatal disturbance. Placental blood transfusion is claimed to have some prophylactic value (Bound *et al.*, 1962) and a means of ensuring this in babies delivered by Caesarean section, a group which is at increased risk, has been described by Secher and Karlberg (1962).

Distressed infants may also show oedema of the limbs, and protein leakage through capillary walls may occur in the premature, but the pulmonary membrane, which contains fibrin, not only suggests an exudate but it is maximum in the alveolar ducts and terminal bronchioles and not in the alveoli themselves where it might be expected, were it part of a general capillary leak.

Present opinion favours atelectasis as being the primary pathological lesion (Gruenwald, 1952; Gairdner, 1965), and all other changes including the cardiovascular ones as secondary to it. Deficiency of surfactant, a lipoprotein which reduces surface tension within the lung and so facilitates the separation of cohesive surfaces (Avery and Mead, 1959), not only makes expansion difficult but makes it unstable so that it collapses on expiration (Gruenwald, 1964). Immature infants are also deficient in fibrinolytic activators (Lieberman, 1959; Quie and Wannamaker, 1960; Ambrus *et al.*, 1965) and may have abnormal difficulty in dealing with the hyaline membrane.

The importance of the metabolic findings has not yet been agreed. Distressed infants have a severe, uncompensated respiratory acidosis during the early hours of life, and evidence of a metabolic acidosis, a rising potassium and excessive tissue breakdown also exists. Usher (1961) believes that the severity of the acidosis correlates closely with the prognosis and he recommends a régime in which the hyperkalaemia and acidosis are controlled from birth by intravenous glucose and sodium bicarbonate. Such treatment, which has been effectively modified by Hutchison *et al.* (1962, 1964), does not effect the primary respiratory process but is said to improve survival rates. The syndrome can be treated by means of mechanically-assisted ventilation, but an attempt to deal with the membrane by intravenous fibrinolysin has been unsuccessful (Gomez and Graven, 1964).

These possibilities, and there are others, serve to illustrate the importance of neonatal physiology as well as of disturbed function.

Heat regulation. Newborn infants, and particularly the premature, may experience difficulty in maintaining normal body temperature should this differ appreciably from that of the environment. Thus, they may become overheated and the brief elevations of temperature which are common on the third or fourth day of life may be relieved by increasing the fluid intake. Although known commonly as 'dehydration fever', the true cause may be more obscure and the possibility of infection must never be out-ruled without careful examination. A fall in rectal temperature is common just after birth (Burnard and Cross, 1958) and exposure of the immature baby to low environmental temperature and to draughts may result in a rapid and progressive lowering of body temperature below 90°F (32°C). Animal experiment suggests that this susceptibility to hypothermia results from the newborn having a lower basal metabolic rate than is appropriate for his surface area and having a smaller maximal metabolic response to cold (Hill, 1961). Some variation exists in this susceptibility to chilling. Recent evidence suggests that in response to lower environmental temperatures the baby may produce more noradrenaline (Sandler *et al.*, 1961), but Dawes (1965) does not accept this as proof that noradrenaline is responsible for increased heat production. Certainly the newborn animal attempts to defend itself against cold, thus increasing oxygen demand in the possible presence of oxygen lack. Thus low body heat is no longer considered to be a desirable achievement in the care of premature babies (Silverman *et al.*, 1958) and evidence is accumulating that the maintenance of body temperature in infants of very low birth weight improves the chances of survival (Jolly *et al.*, 1962; Silverman and Agate, 1964; Buetow and Klein, 1964; Day *et al.*, 1964). When hypothermic the baby feels cold, is often reddish in colour, is inactive and shows at first oedema and then progressive solidifying of the subcutaneous tissue (sclerema). Recovery is possible but re-warming is fraught with such dangers as pulmonary haemorrhage. For these reasons the greatest care should be taken to protect the newborn from both overheating and chilling. Temperatures in hospital should be recorded once daily with individual thermometers, and in the case of premature babies these should read down to 85°F (29·5°C). The subject of neonatal thermoregulation has been fully reviewed by McCance (1959*a*) and Dawes (1965).

Blood. The observations of different authors on the blood during the neonatal period have varied widely, average normal values being given by Gairdner *et al.* (1952). The haemoglobin, which is relatively high at birth, begins to fall during the first month of life and continues to do so during earliest infancy. Approximately 85 per cent is of foetal type at full term, but premature babies have even more. Such haemoglobin resists alkaline denaturation, remaining pink in the presence of sodium hydroxide, and this fact has been used to distinguish foetal from maternal blood in the mother should foetus-to-mother transfusion be suspected, in antepartum vaginal bleeding when signs of foetal distress develop, and in the vomitus or stools of newborn babies in whom haemorrhagic disease is suspected. The packed cell volume, the mean corpuscular volume, the total white cell count and the percentage of neutrophils also diminish rapidly after birth and immature red cells which are present on the first day of life disappear from the peripheral blood. Indeed the life span of the red cell is almost certainly shorter at this age (Garby *et al.*, 1964). The range of the eosinophil polymorph value has been found to be above that of normal adults and shows considerable day-to-day variation. The reticulocytes increase during the first few hours and then fall progressively. The fragility of the red cells at birth may be normal or slightly increased.

The prothrombin level of the newborn infant falls progressively over the first three days of life and rises to normal during the subsequent three to four days. This period of hypoprothrombinaemia (and resultant prolonged clotting time) is in fact coincidental with the age at which the signs of haemorrhagic disease of the newborn appear, and vitamin K has been used in attempts to prevent it. Success was reported earlier by Lehmann (1944) and Dyggve (1950) but Hay *et al.* (1951) found that administration of the vitamin to a large series of pregnant women before delivery failed to influence the incidence of haemorrhagic disease. This condition may, in fact, result from a number of abnormalities, and Smith (1959) expresses the view that the failure of vitamin K to prevent all haemorrhagic disease of the newborn is not surprising. In any case, both the preparation and the dose should be chosen with care for reasons which are given below.

Jaundice. Physiological jaundice is detectable clinically on the second or third day of life in the majority of newborn infants, is normally associated with starvation or exposure to cold increase tissue breakdown, interfere with growth and upset homeostasis. Similarly, an abnormal mineral load in an artificial diet may upset growth and stability. A relatively small increase in the salt content of a milk formula, for example, may by reason of the large volumes of fluid taken by babies result in their ingesting proportionately more salt than a normal adult would do, with the consequent development of sickness and oedema (McCance and Widdowson, 1957).

The neonatal kidney may be regarded therefore as adequate under normal conditions but inadequate to meet abnormal loads, and intravenous therapy which can be of great value must be employed with caution.

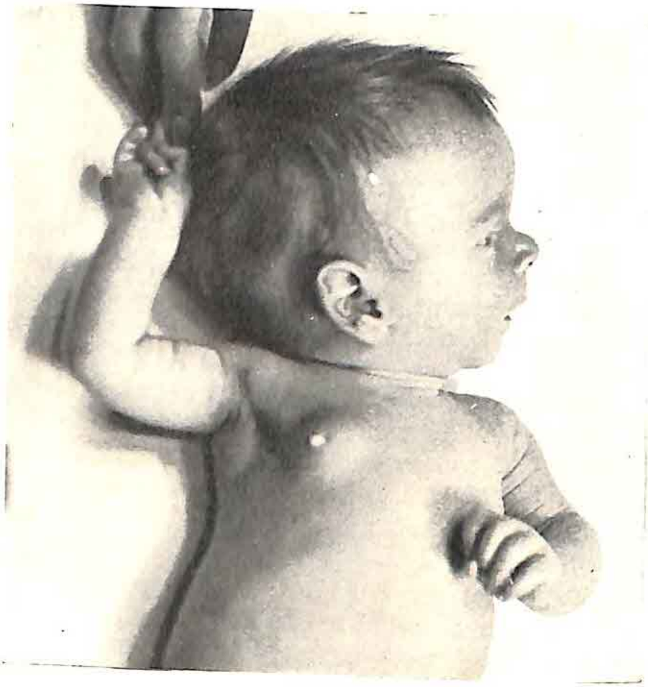


FIG. 6. Breast enlargement in the newborn, showing secretion of witches' milk.

Endocrine system. The developing foetus is exposed to both maternal and endogenous endocrine secretions (Deanesby, 1961) which influence permanent and temporary changes in morphology. At birth the female external genitalia are congested, the labia minora and clitoris are prominent, and to the mucoid vaginal discharge there may be added in occasional cases a little endometrial bleeding. The vaginal mucosa is hypertrophied and contains glycogen but begins to desquamate within the first few days. The uterus is enlarged but involutes from birth. The epithelium of the male utricle, prostatic urethra and prostatic glands may show squamous metaplasia. Breast milk is secreted by most full term and a good many premature infants of both sexes but this 'witches' milk' (Fig. 6) gradually decreases after the newborn period although it may persist for months in some cases. The adrenal glands of the newborn are much larger in proportion to body weight than at any other age. This is due almost entirely to the large foetal zone of cortex which involutes from birth independent of maturity, and the function of which remains obscure (Tähka, 1951). According to Migeon (1959) cortisol can cross the placental barrier from mother to baby and possibly also in the reverse direction. The maternal levels already raised by pregnancy rise further during labour, while the response to Caesarean section is less immediate. In consequence cortisol levels are higher after vaginal than after abdominal delivery. The newborn does not lack corticosteroids during the first few days at least, but they are in part of maternal origin, and because of a deficiency of catabolic enzyme action their half life is prolonged. Migeon believes that differences in the metabolism of steroids at this age may lead to the erroneous interpretation of urinary steroid levels. The urinary output of 17-hydroxy-corticosteroids in premature infants is thought to be less than in full-term babies during the first week, but this difference then disappears (Cranny and Cranny, 1960). The nature of the adrenal steroids found in the pooled urine of newborns has been described by Birchall *et al.* (1961). The adrenal medulla of the newborn infant contains much less pressor amines than do the organs of Zuckerkandl. Both structures produce noradrenaline almost entirely at this age. West *et al.* (1953) were of the opinion that the organs of Zuckerkandl secrete this potent pressor substance in order to maintain vascular tone at a developmental stage when the adrenal medulla and the sympathetic nervous system are still immature. The urinary output of 3-methoxy-4-hydroxymandelic acid, a major metabolite of noradrenaline and adrenaline, increases when the newborn is exposed to lower environmental temperatures (Sandler *et al.*, 1961).

The histology of the thyroid gland suggests the existence of heightened activity before birth and a further powerful stimulus to activity at or about birth, decreasing from the third or fourth day (Sclare, 1956). Thyroxine can probably pass the placental barrier in each direction so that the maternal and cord levels of butyl extractable iodine are very similar. Following delivery the maternal level changes little but a striking rise in the baby can be interpreted as representing the release to the circulation of a considerable quantity of thyroid hormone (Pickering *et al.*, 1958).

The rising serum phosphorus and falling calcium levels during the first few days of life suggest a period of 'physiological' hypoparathyroidism, and these changes may be so increased by feeding the baby on a high phosphorus containing formula that neonatal tetany develops. Kaplan (1942) reported the occurrence of parathyroid gland hypertrophy from the third to the tenth days and suggested that this may be a response to the high phosphorus content of cow's milk. Temporary renal immaturity however is likely to play a part in this disorder. In the endocrine pancreas the ratio of alpha to beta cells in the newborn is normally 1:1, but in the infants of diabetic mothers, presumably in response to some maternal diabetogenic stimulus, the beta cells increase both in number and size, and the pancreas of such babies is able to produce much more insulin than is normally the case (Baird and Farquhar, 1962; Stimmler *et al.*, 1964).

Iatrogenic disease. Clinical experience has recently revealed that drugs which are well tolerated by older children and adults may be dangerous to the foetus when they 'leak across' the placenta from the mother or when they are given to the infant or accidentally come into contact with him after birth. The disastrous effects of thalidomide on the development of the foetal limbs and other structures have intensified research in this field. The androgens (Grumbach and Ducharme, 1960), the androgenic progestagens (Moncrieff, 1958; Wilkins, 1960), and occasionally the synthetic oestrogens (Bongiovanni *et al.*, 1959) may cause masculinisation of the female foetus if given to the mother in early pregnancy. The goitrogenic effect upon the foetus of antithyroid drugs given to the thyrotoxic mother and occasionally of iodides given to the asthmatic or bronchitic one are well known (Wilkins, 1957). The uncritical administration of intravenous infusions to labouring women may cause marked changes in tonicity and sodium concentration in the foetus (Battaglia *et al.*, 1960), and it is possible that dietary restriction of the mother or her treatment with powerful diuretic agents may also do so. Hexamethonium bromide given for maternal hypertension has produced paralytic ileus in the baby (Hallum and Hatchuel, 1954) but is now seldom used. Anaesthetic and analgesic agents may seriously depress the foetal respiratory centre while wild excitation may appear in newborn infants of heroin addicts. The use of succinylcholine as an aid to anaesthesia may cause prolonged apnoea in sensitive babies (Kaufman *et cl.*, 1960), and skin contact with unlaundered marking ink may produce severe methaemoglobinaemia (Ramsay and Harvey, 1959). The use of sulphonamides in neonatal infections is associated with an increased risk of kernicterus (Silverman *et al.*, 1956) and its use in the newborn or in the pregnant woman at term should be avoided. Both aspirin and caffeine sodium benzoate, like sulphafurazole, may *in vitro* split unconjugated bilirubin from the albumin molecule (Odell, 1959) but in the doses used are unlikely to release dangerous amounts of it. When the recommended dose of the vitamin K analogue 'Synkavit' (the diphosphoric acid ester of 2-methyl-1:4-naphtho-hydroquinone) is exceeded, hyperbilirubinaemia may result from increased haemolysis (Allison, 1955; Meyer and Angus, 1956). The latter may be due to an inherited deficiency of glucose-6-phosphate dehydrogenase, but such is uncommon in this country where vitamin E deficiency, hypoglycaemia and other unknown factors may be responsible. The dose should be restricted to 2 mg. or an alternative vitamin K analogue should be used. Chloramphenicol is poorly conjugated and excreted by the newborn (Nyhan, 1961) and should be given in limited dosage if the danger of fatal circulatory collapse, 'the grey syndrome', is to be avoided. Other antimicrobials such as novobiocin and nitrofurantoin have less severe side effects and each should be employed with care. The relationship of oxygen therapy to retrolental fibroplasia in premature babies is well known (Ashton *et al.*, 1953; Patz, 1957). These examples clearly indicated the need for care when foetus or newborn infant is exposed by design or accident to the many new drugs which become available each year. Close consultation between obstetrician and paediatrician on this subject is indicated whenever the newborn presents some unusual disturbance.

The Care of the Newborn

In addition to those features of good antenatal care which are designed to promote normal intrauterine development and uncomplicated delivery, wise preparation of the mother will include not only education about the advisability of breast feeding and preparation for it but also a short course of mothercraft. This latter should comprise lessons on elementary hygiene, feeding and bathing the baby, and the management of simple infantile disorders. Guidance should be given also in the preparation of the layette.

Reception. At birth the infant's eyelids may be cleansed with pledgets of cotton wool, but the custom of instilling 1 per cent silver nitrate drops has been discontinued. Babies delivered in their homes may have sulphacetamide instilled or such other preparations as may be ordered by the local supervising authority, but in hospital it is better to wait and treat energetically any conjunctivitis that may develop. Should local opinion favour delay in clamping the cord until the contracting uterus has effected a placental transfusion of blood, then it may be deferred until eye toilet is complete. It is not always advisable to wait until pulsation of the cord has ceased since the duration of pulsation is very variable and long delay may lead to chilling of the infant. Pulsation may in fact continue for some considerable time after the cord has been cut. After clamping, it should be firmly ligatured and divided. Only a very small quantity of blood should ooze from the cut end and if oozing continues the cord must be religatured. It is essential to keep a careful watch on it throughout the first week since any recurrence of oozing indicates either that the ligature has become insecure or that the infant is suffering from haemorrhagic disease or sepsis. More recently the danger of poor ligation has been greatly reduced by the use of disposable plastic clamps or by means of elastic bands (Neligan *et al.*, 1964). The dying cord tissue provides an ideal pabulum for bacteria and under certain circumstances it may provide the portal through which common pyogenic bacteria and the toxin of tetanus gain entry. Practice with regard to its care falls into two main categories—protection with a sterile dressing and exposure. Should sterile dressings be used, they are generally applied after the cord has been dusted with a suitable powder, and they are then kept in place with a thin crepe binder which should not restrict respiration. Where the cord is left exposed, and this practice is gaining favour, it is usually painted daily with gentian violet or some other antimicrobial and all dressings are avoided.

The squeeze exerted on the baby's thorax during vaginal birth assists in the expulsion of fluid from the airway, but the fear that he may be drowned by such secretions often excites such unnecessary fervour over pharyngeal aspiration that harm may result. In most cases positional drainage will be all that is required and this may be done before the cord is cut by laying him on his back across the mother's thigh so that head and arms hang down or in the inclined plane of a mobile resuscitation trolly. Fluid can then drain freely from the lungs and the chest can expand readily. It is always advisable to have available some sort of equipment by means of which fluid can be sucked out of the oropharynx if necessary. This may be simply a small soft rubber catheter attached to a glass 'trap' (Fraser, 1951), but advantages exist in having multiple sterile catheters and a mechanical source of suction the negative pressure of which can be controlled and which not only frees the nurse from the unpleasant and even hazardous task of sucking but removes the danger to the child of a nurse who also blows through the catheter. Suction is more frequently required after Caesarean section.

Even a normal labour exposes the infant to appreciable stress and the greatest care must be taken to avoid chilling and rough handling after birth. The infant should be wrapped in a warm sterile towel as soon as practicable; there is no urgency about the ritual cleansing unless infection of the maternal passages is suspected.

The cot should be very simple and easily portable. For hospital use a metal frame box cot covered with washable material adequate to screen the baby from draughts has obvious advantages. It should contain a washable mackintosh-covered mattress. The addition of lockers (Fig. 7) enables articles personal to the baby to be kept with him (Farquhar, 1960). At home a carry-cot will suffice for much of the first year and is also very useful if the baby is taken visiting. The dangers of hot water bottles and of electric heating pads are so great that they should be avoided wherever possible.

General examination. Shortly after birth the infant should be thoroughly examined in a good light. Any congenital abnormality such as club foot or cleft palate and any evidence of birth injury should be noted. The heart must be carefully examined and the femoral pulses should always be felt in order to exclude aortic coarctation. It is most important to make certain that the orifices are patent and that the infant passes urine and meconium during the first 24 hours. The abdomen should be palpated to make sure that the bladder is not distended. The presence of a pilonidal depression at the base of the spine is not of clinical importance unless it leads to a true sinus, but care should be taken to exclude epidermal sinuses higher over the spine. The genitalia and inguinal regions should be examined to exclude hernia, hydrocele, maldescent of the testicles or adhesions of the labia. Birthmarks should be noted. If either parent has Mongolian or Negro blood it should be remembered that 'Mongolian blue spots' may be present on the buttocks or sacral area and are apt to be mistaken for echymoses.

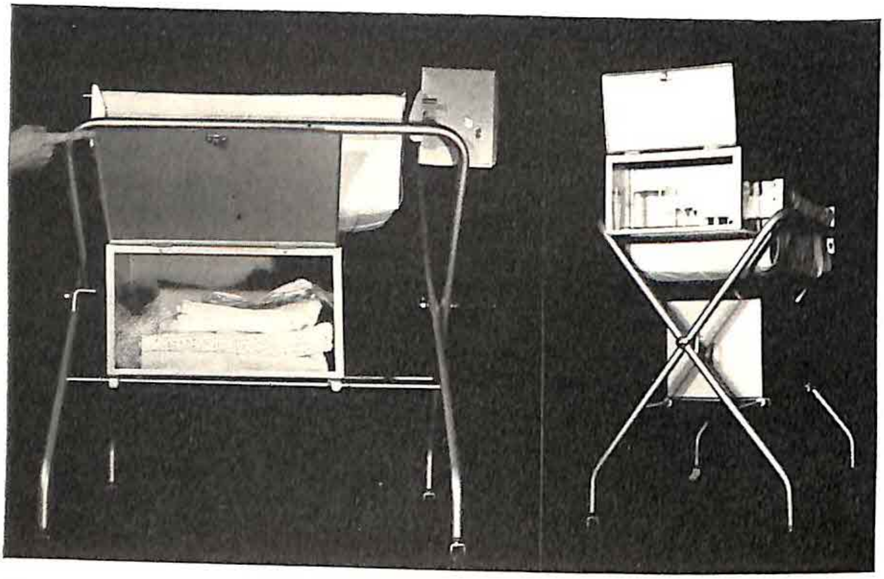


FIG. 7. A cot suitable for the rooming-in of baby with mother. The large locker contains wraps, gowns, blankets and napkins; the small one has a thermometer, woollies and ointments.

The prepuce is very commonly adherent to the glans and is not fully retractile at birth. In a high proportion of cases it will become retractile later. The circumcision of newborn infants is often recommended much too lightly and the case against it has been fully reviewed by Gairdner (1949) and Weiss (1964). The report of the first year of the Newcastle thousand family survey (Spence *et al.*, 1954) showed that 11 per cent of the boys were circumcised, and of these circumcisions no fewer than 22 per cent were complicated, usually by haemorrhage and infection. In no case should the infant be circumcised during the first eight days of life because of the physiological hypoprothrombinaemia of that period or when jaundice is present. One of the few medical grounds for circumcision of the newborn, as distinct from the demands of religion or fashion, is the presence of a preputal orifice so small as to cause obstruction and ballooning of the prepuce during micturition. This condition is rare.

The breast enlargement which may accompany the common secretory activity of male and female infants requires no treatment and attempts to express the milk only predispose to mastitis. Congenital dislocation of the hip may be diagnosed at this age and it should be looked for routinely as early treatment will be more effective and less disturbing to the child. The knees may normally be abducted more than 45° from the midline and limitation of this should arouse suspicion. When testing, the hips are flexed to 90°. Each thigh is gripped firmly from the back so that the examiner's thumbs lie on the medial aspect and can abduct the thigh while his fingers lie just behind the femoral head and can lift it forward. By alternately abducting and adducting at the hip joint distinct 'clunks' may be felt as the dislocated or unstable femoral head enters and leaves the acetabulum.

HEAD. The occipito-frontal circumference of the head should be measured with a steel tape within 24 hours of birth. Head-moulding, which is normally present at birth except in elective Caesarean deliveries and a proportion of easy breech extractions, varies in degree from minimal distortion of the skull to overriding of the sutures. Unless it is accompanied by intracranial damage, it has no permanent effect and moulding tends to become less obvious during the first week of life. The presence of a caput succedaneum, or oedematous area over the part of the head which has presented during a prolonged labour, is often observed at birth, and in the case of a face presentation may be associated with great discoloration. This normally disappears rapidly, leaving no permanent disability.

A *cephalhaematoma*, or large fluctuant swelling, limited by the suture lines and due to the presence of blood under the periosteum, may appear on the second or third day after birth. It is due partly to local trauma, but is also probably related to hypoprothrombinaemia, though not commonly associated with other evidence of haemorrhage. If uncomplicated, it is of no serious significance and calcification and absorption will occur spontaneously. Since calcification starts at the margin, a calcifying haematoma is sometimes mistaken for a depressed fracture.

The *anterior fontanelle* is readily palpable at birth and varies greatly in size. It is normally pulsatile, but if it is found to be tense or bulging when the infant is at rest, intracranial haemorrhage or hydrocephalus should be suspected. The sutures are often more easily palpable than in the older infant, and one or more of the five other fontanelles present at birth may often be identified clinically.

TRUNK. Although the thoracic cage is relatively soft and flexible during the newborn period, and the respiratory excursion is slight, it should be possible to detect inequality of movement or deformity of the ribs, *e.g.* due to fracture. The abdomen appears relatively large in the newborn infant, and moves freely with respiration. The liver edge is normally palpable one or more finger-breadths below the costal margin, but the spleen is not felt unless it is pathologically enlarged.

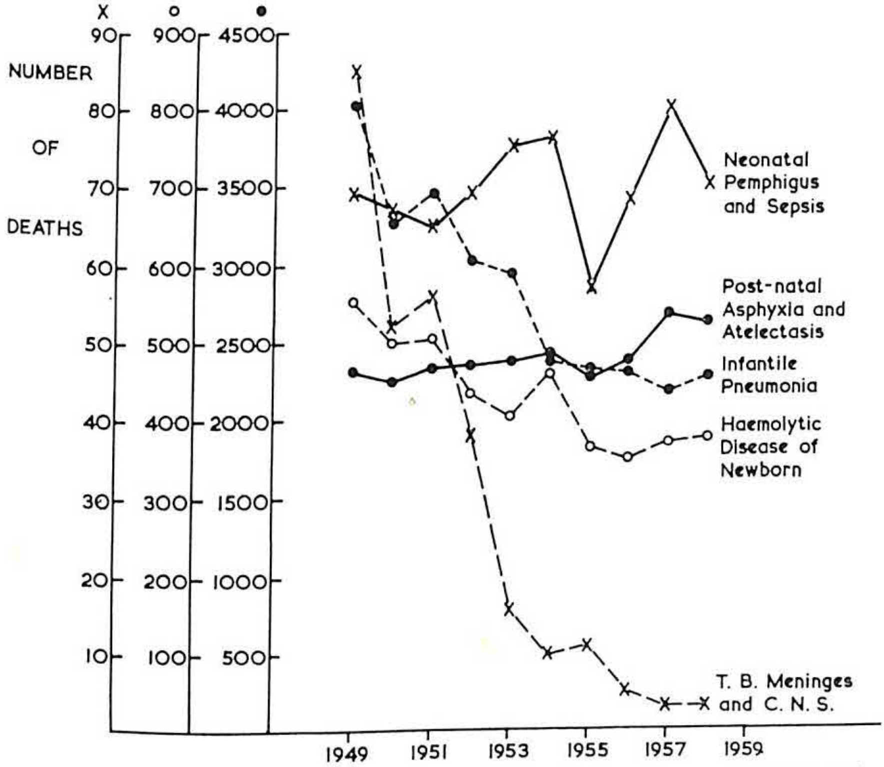
The umbilical cord rapidly becomes white or semi-translucent in colour after it has been tied, and shrivels during the time that it remains attached. Separation normally occurs spontaneously about seven days after birth, but the cord may remain attached considerably longer in premature infants. When the cord has separated, the umbilicus should be dry. Any stickiness or bleeding of the umbilicus is a danger signal, as it suggests the presence of sepsis.

SKIN. The skin of the infant at birth is usually erythematous and normally shows no appreciable jaundice. The pinkness tends to fade during the first few days of life and during this time icteric tinting appears. The full-term infant is well supplied with subcutaneous fat, and the skin is elastic; the nails extend slightly beyond the nail-beds; lanugo is usually slight in amount, though there is a variable amount of soft, silky hair on the scalp. Occasionally infants are born with a thick mass of dark hair of coarser texture. This tends to fall out during the sixth or seventh week of life and to be replaced by the more typical fine silky hair of early infancy. Milia on the face are commonly seen, and small naevi on the frontal and occipital regions are so frequent as to be popularly known as 'marks of the stork's beak'.

Any rash occurring during the neonatal period should be carefully noted and the cause sought, *e.g.* congenital syphilis, sepsis, or maternal scabies.

Accommodation and the Prevention of Cross-infection

Wherever the baby is nursed his cot should be screened from draughts and a stable room temperature of about 65°F (18·5°C) maintained. Babies born at home must also be protected from fluctuations in room temperature and overheating is as liable to cause distress as chilling. The advantages to the mother of institutional delivery at least for the first baby are generally felt to outweigh the possible disadvantages, but the extent to which this faith is justified depends largely on the standards of the hospital available. Where the mother is given full opportunity of learning the care of her own infant she would derive full benefit from the skilled nursing and rest which are now seldom equally possible in the home. The common disadvantages of hospital, however, lie in the impersonal and often hurried institutional atmosphere, such monopoly of the baby by overworked nursing staff that his mother may gain little experience in infant care during her stay, and the serious danger of cross-infection with antibiotic resistant bacteria. Such infections, commonly staphylococcal or coliform have prevented reduction in the number of deaths from neonatal sepsis during the past decade (Fig. 8) and, apart from mortality, cause a great deal of disability. anxiety and expense. The organisms may spread from baby to environment, from environment to baby, and between babies. The agitation of dust by cleaning, bedmaking, and excessive traffic in an overcrowded unit may result in a heavy staphylococcal fall-out which may be reduced by coating floors with dust-


DEATHS OF INFANTS UNDER ONE YEAR FROM CERTAIN CAUSES, 1949-1958

REGISTRAR GENERAL (1958 part I, table II, p. 66.)

FIG. 8. Deaths from neonatal infection and pemphigus have not decreased during the past decade.

trapping preparations, wet cleaning, piped vacuum cleaning from a central department, the sterilisation of cotton blankets and their impregnation with antiseptic, the provision of suitable bins for the disposal of soiled articles, and the strict limitation of hospital population. The hospital staff are of fundamental importance because, colonised as they may be by resistant organisms, they make intimate contacts with the newborn by means of hands, upper respiratory tracts, clothing, and possibly their hidden septic lesions. These dangers may be lessened by reducing the number of contacts between babies and staff, by strict discipline in hand-washing and personal hygiene with regard to bathing and all clothing, by replacing personal handkerchiefs with tissues and providing means for their disposal, and by maintaining such an adequate ratio of staff to patients that efficiency can be maintained. This will make necessary the provision of adequate numbers of wash-hand basins with wrist- or foot-operated taps, continuous roller or disposable towels, antiseptic hand creams, and the frequent re-education of all staff in barrier nursing technique.

Infection may be transmitted also from infant to infant. Some described by Eichenwald *et al.* (1959) as 'cloud babies', seem to shed pathogens around them and may contaminate their neighbours in an over-crowded unit or the staff who handle them. Others will spread infection at such concentration points as changing tables, weighing machines, communal ointments, hair-brushes, towels and baths. Some of these can be avoided altogether, contact with others can be much reduced in frequency, and precautions can be taken to reduce the bacterial population of tables and weighing scale pans by using plastic rather than cloth coverings and by mopping them with a bactericidal detergent between babies.

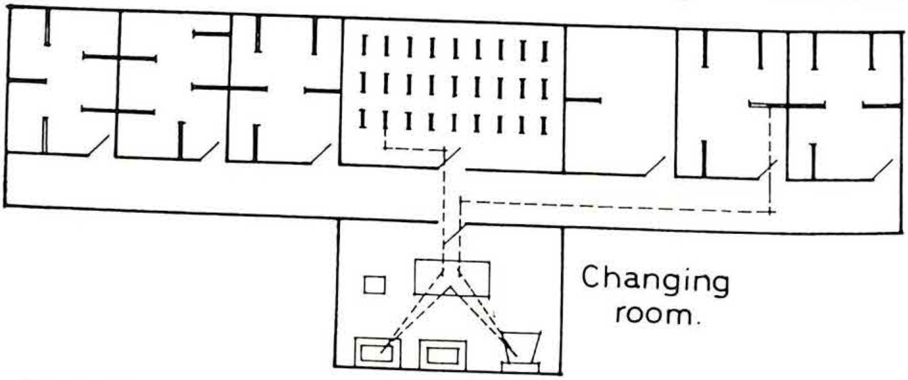


FIG. 9. The route along which a baby passes from a central nursery suite to his mother, illustrating the transport and contact problem.

The care of the baby's skin is an important measure in reducing sepsis. It may be cleansed with a good baby soap, but hexachlorophane may be very effective in reducing the incidence of sepsis. Portable and easily sterilised baths are useful for cot-side bathing in the mother's room, but routine cleansing of the napkin area may be carried out in the cot. In the case of feeble infants and when there is much vernix caseosa, cleansing is best carried out with warm olive oil. Chilling must be avoided. After the skin has been washed and gently patted dry, the flexures should be dusted with a good baby talc. The nails should be kept short and clean to prevent infection from scratching. Adequate provision must be made for the isolation of both suspect and established infections, and an agreed policy designed to control the use of antibiotics is very desirable.

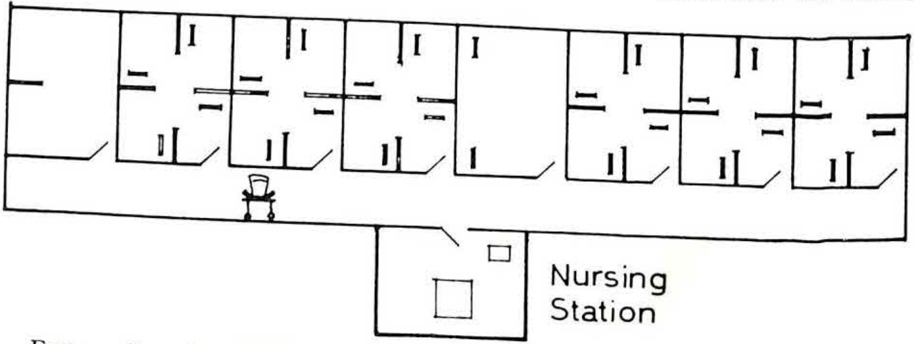


FIG. 10. Rooming-in, illustrating the absence of transport and contact problems.

Elaborate air filtration plants may create an entirely false sense of security unless they are known to be efficient and to be regularly serviced. Even then they are of little value if the clean air provided is later contaminated by careless staff. The central nursery suite system (Fig. 9) is not necessarily associated with a high incidence of cross infection, but should a virulent organism be introduced, then the over-crowding, the concentration points, the need to transport babies to and from their mothers, and the many members of staff involved in their care make the prevention of cross infection difficult. Many of these contacts can be removed by rooming the baby beside his mother (Fig. 10), by making her responsible for his care, and by providing personal facilities for weighing, bathing and changing him. This will prove effective, however, only if the supervising staff observe efficient barrier nursing technique. It also gives the mother greater confidence in handling her baby, but unless the number of patients in each room is small it can be very disturbing at night.

A third system, cohort care, consists of a battery of air-conditioned rooms into which infants born on the same day are admitted, thus reducing the risk of older, bacteria-colonised, babies infecting younger ones. Enough rooms are provided to ensure that some are always empty and being cleaned. The mothers can nurse their own babies, although where the system applies, the nursing staff often assumes complete care of the baby and bottle feeding is routine.

Care of the Premature Baby

The difficulties of establishing respiration become greater with decreasing maturity and birth weight of the baby. The cause of premature birth may itself have a depressing effect on the respiratory centres while a softer chest cage and deficient surfactant material are major problems. The need for skilful resuscitative measures should therefore be anticipated at all premature births and provision should be made where possible for the treatment of the idiopathic respiratory distress syndrome. Oxygen may be used safely for the relief of anoxia but, because of the danger of causing retrolental fibroplasia, should not be employed as a routine. When used for the treatment of asphyxia or distress, the concentration should be reduced to about 30 per cent when cyanosis has been relieved, and oxygen should be discontinued whenever possible.

Body heat should be preserved by nursing the infant at an environmental temperature in the range 90 to 92°F (32·2 to 33·3°C), and recent observations on caring for babies of very low birth weight suggests that servo-controlled incubators give better results. The heating mechanism of such machines is automatically controlled according to the baby's skin or rectal temperature, this being monitored continuously by a thermistor. The principal advantages of any modern incubator are that the nursing and medical staff can enjoy their own optimum environmental temperature without depriving the baby of his, and that the infant is less exposed to infection. While such advances may improve the care of the premature, they are quite beyond the financial resources of many lands where other public health matters are of greater importance. Yet excellent results in the management of prematurity are being obtained in Asia and Africa even where the outside temperature falls to freezing-point. Simple draught-free cots or boxes may be fly-screened with gauze, and the temperature may be maintained by the use of stoves, or cooling may be facilitated by fans and screens.

The feeding of large premature babies (over 2 kg. body weight) creates a problem only if the baby is sick in some way, *e.g.* respiratory distress. The feeding of smaller premature babies remains a controversial subject. Their respiratory difficulties, cyanotic attacks and poor cough have created justifiable anxiety so that fluids have often been introduced for the first time as late as the third or fourth day of life, and even then in small volumes. Where this principle is still followed, the first feed may consist of 10 ml. per kg. of body weight at each feed, repeated three-hourly throughout the 24 hours. If this is tolerated, a change is made to expressed breast milk, to a humanised milk or to a dilute (one in six) unsweetened condensed milk, and the strength and volume are increased according to the baby's appetite and progress. The smaller the baby the likelier is tube-feeding to be necessary, and there is a general move toward the use of fine plastic catheters which are passed through the nose and which require only infrequent changing. Once in the correct position these help to conserve the baby's energy and the nurse's time, and they are probably safer than tubes which need to be passed for each feed. Small babies graduate to, and larger ones start with, feeding bottles according to their ability to suck, and assistance may be given at first with a Belcroy feeder by means of which the nurse may gently expel milk into the baby's mouth.

Concern about the poor results of the current treatment of prematurity and about the relationship of delayed feeding to dehydration, hypoglycaemia and hyperbilirubinaemia have moved some paediatricians to much earlier and fuller feeding of the smallest babies (Smallpiece and Davies, 1964; Farquhar, 1965*c*). They have shown that this can be done with safety by skilled nurses, but the advantages, if any, remain to be seen. The use of cow's milk formulae during the first few days of life when enzyme reactions and renal function are immature may in theory create such problems as phosphate retention with tetany or raised plasma amino-acid levels, but the clinical results have not confirmed these. Older babies will certainly be fed according to appetite and should have supplements of iron and vitamins at the age of one month. Ferrous sulphate mixture containing 50 mg. in 4 ml. may be gradually introduced and increased to three such doses daily until appropriate mixed feeding has been established, while the premature requires a larger daily dose of vitamin D and 800 units daily has been recommended. Such small babies are more susceptible to infection as newborns and, perhaps because of nutritional deficiency or environmental circumstances, may remain so during the first few years. The dose of chloramphenicol in the first week must be appropriately reduced.

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Chapter 4

PREMATURITY AND LOW BIRTH WEIGHT

Definition

A BIRTH weight of $5\frac{1}{2}$ lb. (2,500 g.) or less has been accepted as the criterion of prematurity since this recommendation was made at the First World Health Assembly in 1948 (W.H.O. 1948) and endorsed as the international definition to be used by member countries by the W.H.O. Expert Group on Prematurity two years later (W.H.O. 1950).

In a literal sense the term prematurity means only a shortened period of intrauterine existence. In general gestational age gives a better indication of the likelihood of special postnatal care being required than does birth-weight, and also a better prediction of later development. However, gestational age can only be estimated with reasonable accuracy in 80 to 90 per cent of births in communities with fully developed maternity services (Walker, 1965) and in a much smaller proportion of births in less advanced countries, since the estimate depends on the mother's memory with the possibility of further errors being introduced by variations in duration and regularity of the menstrual cycle and misinterpretation of preconceptional amennorhoea or post-conceptional bleeding.

Although the birth-weight definition of prematurity has proved to be inapplicable in many countries as an indication of the number of infants requiring special care, it has provided a useful social index, being closely related as are the stillbirth and infant mortality rates, to living standards, physique and nutrition of mothers and adequacy of maternity services.

The upper limit of $5\frac{1}{2}$ lb. chosen in 1948 was based mainly on the known birth-weight range in white infants, and its was anticipated then that the definition adopted might prove to be inappropriate for other races. A further study of birth-weights in eighteen countries in different parts of the world was initiated by W.H.O. in 1957. A preliminary analysis (Crosse, 1960) based on 23,000 hospital deliveries showed that a substantial proportion of babies included within the limits of the previous definition are not born prematurely and do not require special postnatal care. In countries with a high proportion (over 15 per cent) of infants weighing 2,500 g. or less at birth, the excess of low-weight babies was due to a small increase in the number of infants born before 37 weeks' gestation and a much larger increase in the number of babies with weights between 2,000 and 2,500 g. (4·4 and 5·5 lb.) born at or near term. Although a wide range was found in mean birth-weights and incidence of prematurity by birth-weight in different communities, mean gestational ages were not much different. The W.H.O. Expert Committee (1961) has now recommended that the term 'low birth-weight' should be used instead of 'premature' to describe infants included in the previous definition. Even in advanced countries a substantial minority of so-called prematures are low-weight babies born at or near term. In Great Britain about 7 per cent of all live-born infants are $5\frac{1}{2}$ lb. (2,500 g.) or less at birth, but of these 30 to 45 per cent are born after 37 completed weeks of gestation (Drillien, 1957; Walker, 1965). Nearly one-half of infants classified as premature have birth-weights between 5 and 5½ lb. (2,250 and 2,500 g.) and over one-half of surviving infants are in this birth weight group. Most of these infants are not prematurely born. Their postnatal requirements and later development may be expected to differ radically from those smaller babies who are premature not only by birth weight but also by gestational age.

It would seem logical, therefore, to divide babies of low birth-weight into three main groups: (1) those of birth-weight 5½ lb. (2,500 g.) or less born after 37 completed weeks of gestation, and (2) those born before 37 completed weeks. Within the second group there is found to be a further important subdivision according to whether or not the infant is at or below the appropriate weight for his gestational age.

Factors Affecting Birth Weight and Period of Gestation

Low weight at birth and shortened gestation period are related to social background, constitutional factors in the mother and foetus, and to circumstances arising during the course of pregnancy.

Social factors. Numerous authors have noted the relationship between low birth-weight and adverse social circumstances, using as social indices such pointers as different racial groups in the same community (Eastman, 1947); the use by mothers of free or fee-paying maternity services (Baird and Illsley, 1953); standards of housing (Gibso.. and McKeown, 1951), and occupation of husbands (Drillien and Richmond, 1956).

In Great Britain the Registrar-General's Occupational Classification (1951) provides a useful indication of general environmental influences. This classification into five social classes is used in national statistics of morbidity and mortality and is commonly employed as a standard when relating health problems to social and economic background, making it possible to compare the findings of different workers.

In Aberdeen (Baird and Illsley, 1953) and in Edinburgh (Drillien and Richmond, 1956) the prematurity rate in Social Classes I and II was less than one-half that found in Social Classes IV and V with the rate in Social Class III coming midway between the two extremes of less than 5 per cent and more than 10 per cent. In Edinburgh the proportion of large babies weighing more than 7½ lb. (3,400 g.) at birth was more than twice as high in Social Class I as in Social Class V, after allowing for class differences in maternal age and parity.

In the Aberdeen study (Baird, 1964), the incidence of low-weight babies was found to be influenced by height of mother as well as by social class of husband, with a range from less than 2 per cent of babies born to tall women (5 ft. 4 in. and over) in Social Classes I and II, to nearly 15 per cent of those born to short women (under 5 ft. 1 in.) in Social Classes IV and V. The proportion of short women was much higher in the lower social classes. Baird also found that at each level of maternal height the proportion of low-weight babies decreased as the pre-pregnancy weight of the mother, and her weight-gain during pregnancy increased, with the exception of babies born to mothers having an excessive gain during pregnancy associated with toxaemia.

A similar association between low birth-weight, premature delivery, social class and maternal height was found in Edinburgh (Drillien, 1957). In a mature control group height of mother was correlated positively with weight of baby (*i.e.* the taller the mother the bigger the baby), whereas in a group premature by birth-weight the relationship was reversed; the mothers of the larger babies (most of whom were born at or near term) were significantly shorter than mothers of the smaller babies who were mostly premature both by birth-weight and gestation time.

The Edinburgh study suggested that the social class into which a woman marries (*i.e.* that of her husband) has only a minor influence on her chance of having a baby of low birth-weight compared with the social class in which she was born and brought up (*i.e.* that of her father). When social class and mother's height were considered together, it was found that liability to premature delivery was correlated with social class of upbringing, but no independent effect of maternal stature could be demonstrated. Liability to produce a small baby at or near term was correlated about equally with social class and maternal height. It is probable that genetic constitution is involved in some instances of short mothers having babies of low birth-weight at term. In other cases short height of mother is more likely to be the result of malnutrition during her growing period.

Of the various social factors examined in this study the probable standard of care received by the mother herself in her own childhood was most closely correlated with her liability to produce later a baby of low birth-weight with or without a shortened gestation period.

In any given social class the mother whose customary diet before and in the early months of pregnancy was considered inadequate, appeared to have an extra risk of premature delivery, although no independent effect of inadequate diet could be demonstrated in those mothers having low-weight babies at or near term. There was an obvious association between inadequate diet during pregnancy, and inefficiency of the maternal grandmother, probably due to the fact that a mother's dietary habits in adult life tend to reflect the customary diet in her home of upbringing. For this reason it was felt that the association of inadequate diet in early pregnancy with premature delivery reflected the long-term effects of malnutrition during the mother's childhood and early adult life rather than the effect of inadequate diet during the pregnancy itself.

There is little agreement about the effect on birth-weight of supplementing diet during pregnancy. On the one hand, some workers (*e.g.* Ebbs *et al.*, 1942; Burke *et al.*, 1943; Cameron and Graham, 1944) have claimed that the incidence of low-weight babies is reduced if a good diet is taken during pregnancy or if special supplements are given. On the other hand, reports from countries affected by war and famine (*e.g.* Norway under Nazi occupation, Boe, 1951; Holland in the six-month period before liberation, Smith, 1947) have shown that gross undernourishment in mothers during pregnancy results in only a small increase in low birth-weight babies and premature deliveries. During the siege of Leningrad the incidence of prematurity by birth-weight reached a peak of over 40 per cent in 1942, but here the mothers not only suffered extreme hunger but were subjected to severe and unaccustomed physical exertion as well as incessant bombardment (Antonov, 1947). In general, gross malnutrition appears to reduce fertility and increase the risk of abortion in those who conceive, rather than affect the birth-weight or gestation period of foetuses surviving to the third trimester.

It is not always appreciated that the association of social class with low birth-weight becomes weaker as birth-weight decreases. Babies in the birth-weight range 4½ to 5½ lb. (2,040 to 2,500 g.) are the most likely to be born to mothers in the lower social classes (Drillien and Richmond, 1956). The social class distribution of parents of babies weighing less than 4 lb. (1,800 g.) is not much different from that of the general population (McDonald, 1964*b*).

Maternal factors. The incidence of low birth-weight varies with age, parity and marital status of the mother, though it is likely that to a greater or lesser extent the effect of these factors is related to associated social class differences rather than to variations in maternal physiology. For all parities the proportion of low-weight babies is lowest for those born to mothers aged 20 to 34 years and for all maternal ages the incidence is highest in first births and lowest in second births.

The incidence of low-weight babies in Edinburgh (Drillien and Richmond, 1956) was approximately twice as high in married primiparae who were 19 years or younger and in those who were 35 years or older as in mothers of 20 to 34 years. However, it was noted that premarital conception increased with decreasing age of mother and after exclusion of infants conceived before marriage from all age groups the prematurity rate by birth-weight in teenage mothers was only slightly higher than that in mothers aged 20 to 34 years. Moreover, twice as many of these young mothers had babies weighing 7½ lb. (3,400 g.) or more than did primiparae of 20 years or older. Biologically, the youngest mothers seemed to be the most successful in their pregnancies and the oldest mothers the least successful. The reported relationship of young maternal age with low birth-weight is probably due mainly to associated social factors. Similarly, the increase with parity of mother is likely to be due to the positive correlation between size of family and social class as well as to advancing age of mother. In Edinburgh, women with husbands in Social Classes I and II maintained their low prematurity rate with all births after the first, whereas in other social classes the prematurity rate tended to rise with third and later births, reaching a figure of 18 per cent for sixth and subsequent pregnancies. High parities of this order were seldom encountered in Social Classes I and II.

In Edinburgh births 1953–54, 8·7 per cent of illegitimate infants were considered premature on a weight basis compared with 6·4 per cent of legitimate infants. The increase in the illegitimacy rate was more marked for infants of birth-weight 4½ to 5½ lb. (9·0 per cent) than it was for the smaller prematures (7·7 per cent).

Maternal reproductive capacity also appears to have a bearing on the mother's liability to have a baby of low birth-weight and a shortened gestation period. In Edinburgh the incidence of low-weight babies born to primiparae of all social classes was significantly higher when conception was delayed. In Social Classes I and II the incidence rose sharply when the first birth occurred three years or longer after marriage. In Social Classes III, IV and V, where contraceptive precautions are less commonly taken, a similar rise occurred when the first birth was delayed until two years or more after marriage. In a Californian study

(Wilson *et al.*, 1963) the effects of 22 variables presumed to be associated with birth-weight (including reproductive history of mother, pregnancy history and various social indices) were analysed by means of multiple regression and single variable analysis computer programmes. The most highly significant association found with the lowest birth-weights of 1,500 g. (3·3 lb.) or less was previous infertility, defined as an infertile period of three years of attempted pregnancy.

Mothers of small prematures (1,500 g./3·3 lb. or less) not only have fewer conceptions for any given duration of marriage, but also lose more of their other conceptions by abortion, stillbirth and neonatal death than do mothers in the general population. Surviving siblings are also likely to be of low birth-weight (Drillien, 1964).

Foetal factors. Weight at birth will vary according to sex and whether the baby is a singleton or a twin. At term male infants weight about 4 oz. (115 g.) more than females. In a recent national sample of singleton births (Butler and Bonham, 1963), 6 per cent of males were 5½ lb. or less at birth compared with 7·4 per cent of females. Of total low-weight births 54·0 per cent were females. In the highest birth-weight group (*i.e.* over 4,000 g./8·8 lb.), 64 per cent were males.

It is generally assumed that for like birth-weights females are slightly more mature than males at all gestational ages. However, a report on birth-weights of live-born negro infants (Freedman, 1961) suggests that weight difference by sex develops during the last 4 to 6 weeks of the normal 40-week gestation period. Freedman found little difference in birth-weights of male and female premature infants of 28 to 35 weeks' gestation. Another recent American study of weights of live-born white infants (Lubchenco *et al.*, 1963*a*) noted consistently higher birth-weights in male infants from 24 to 34 weeks' gestation, but amounting to only about 65 g. (2 oz.); from 35 weeks' onwards the excess weight of males was twice that figure.

Infants resulting from multiple births are significantly smaller than single-born infants. Twins born at or near term are on average between 500 and 750 g. (1 and 1·5 lb.) lighter than singleton infants of like sex and gestational age. In addition, there is an increased tendency for twins to be delivered prematurely. In the Denver study of intrauterine growth (Lubchenco, 1963*a*), median weights of singletons and twins were similar until 34 weeks' gestation. From 35 to 42 weeks there was a progressive deviation of the median weight of twins from the 50th percentile to the 10th percentile for singleton births.

Rates of multiple pregnancy increase with maternal age. Forty-two per cent of twins are born to mothers of 30 years or older compared with 32 per cent of single infants. The relationship of multiple birth with maternal age is caused by increasing age of mothers of dizygotic twins, the age distribution of mothers of monozygotic twins being very little different from that of mothers of single infants. Among dizygotic twin pregnancies there are also significant but unexplained differences between legitimate and illegitimate births, the illegitimate rates increasing more steeply with maternal age and having larger values in the peak age groups (Registrar-General, 1964).

Developmental malformations, more especially major anomalies, are likely to cause or be associated with retardation in intrauterine growth, affected infants being not only of low birth-weight but often being markedly underweight for their gestational age (Colman and Rienzo, 1962; Warkany, Monroe and Sutherland, 1961).

Babies found to have chromosomal abnormalities also have poor foetal weight gains, as do those with certain conditions known to be due to single gene defects (Schutt, 1965).

Pregnancy factors. Low birth-weight may be due to maternal complications during the course of or coincident with the pregnancy, because of premature delivery (whether spontaneous or induced) and/or because of the effect of certain complications on intrauterine growth. In an analysis of nearly 8,000 births in an Edinburgh maternity hospital (Drillien, 1947*a*), the proportion of babies weighing 5½ lb. (2,500 g.) or less born to married primiparae, who had received regular antenatal care from the third month of pregnancy, was 4·5 per cent of those born after uncomplicated pregnancies and over three times this rate following pregnancies complicated by toxaemia and antepartum haemorrhage. Baird (1964) found a similar association between pregnancy complications and low birth-weight. In addition, he reported that whereas antepartum haemorrhage was associated with a raised incidence of low-weight babies in all social classes, the effect of toxaemia on birth-weight was most marked in Social Classes IV and V.

In a study of all legitimate surviving infants in Dundee 1960–63 (Walker, 1965), pregnancy complications were related both to birth-weight and gestational age. Babies who at birth weighed less than the 25th percentile of expected weight for gestational age were considered to be 'poorly grown'. Of the total group of infants weighing 5½ lb. (2,500 g.) or less at birth, 40 per cent were born after 37 completed weeks of gestation. Pregnancy was complicated in less than one-half of these poorly-grown babies born at or near term.

Some clinical cause could be assigned to 87 per cent of poorly-grown babies delivered prematurely (who comprised 22 per cent of the total of low birth-weight babies), the more important causes being congenital defect, antepartum haemorrhage and toxaemia.

Some clinical cause could also be assigned to 80 per cent of well-grown babies delivered prematurely (25 per cent of the total of low birth-weight babies). Antepartum haemorrhage was the most important clinical condition in these cases. Spontaneous rupture of the membranes followed after some hours or days by the onset of labour, was found in one-tenth. This appears to be a definite clinical entity, possibly due to some abnormality of the membranes (Crosse, 1961).

It has been suggested that repeated, apparently unexplained late abortions and early premature deliveries may be due to incompetence of the cervical os (Shedden Adam, 1959) and psychogenic disturbance (Tupper, 1960; Wortis and Freedman, 1962).

Women who smoke during pregnancy are found to have rather smaller babies than those born to non-smokers (Herriot *et al.*, 1962). This is not due to differences between smokers and non-smokers in maternal stature, age, parity, social class or food intake during pregnancy. It is suggested that 'the immediate effect of smoking is to cause a temporary decrease in placental circulation which may lead to some degree of foetal malnutrition'.

Retarded Foetal Growth

From some recent studies of survival rates and later development of low-weight babies, it appears that infants who are of low birth-weight and also markedly below the expected weight for their gestational age are at special risk of perinatal death or later handicap.

At present there are no generally accepted standards for the mean and range of birth-weights at different gestational ages. The first report of the British Perinatal Mortality Survey (Butler and Bonham, 1963), gives birth-weight distribution in 500 g. weight-groups at two-week gestation intervals for a national sample of all births during one week in 1958, and all still-births and neonatal deaths during three months. It is to be hoped that more precise figures giving means, standard deviations and percentile rankings, by sex for birth-weights at different gestational ages will be made available later, thus providing standard measurements for the use of other workers in this country.

Equally, there is no general agreement as to what degree of foetal growth retardation should be considered pathological. McDonald (1965) uses the term 'small for dates' to describe babies of low birth-weight who are two standard deviations or more below the mean weight for gestational age. This author constructed mean weights from observations made on all live and stillbirths in Birmingham in 1947 (McKeown and Gibson, 1951).

Warkany, Monroe and Sutherland (1961) suggested that the term 'intrauterine growth retardation' should be applied to infants having a birth-weight 40 per cent or more below the expected weight for gestational age. Lubchenco (1963*a*) considers that a birth-weight at or below the 10th percentile indicates marked growth retardation, whereas Walker (1965) uses the term 'poorly grown' to describe the infant whose weight at birth is below the 25th percentile.

The multiple aetiology associated with intrauterine growth retardation is discussed at length by Warkany, Monroe and Sutherland (1961), and Gruenwald (1963). Retarded growth may be due to genetic factors; to adverse environmental influences in early foetal life, in which case congenital defects are likely to be present in addition to retarded growth; and to late pregnancy complications, among which toxaemia appears to be the most important.

The conception of placental insufficiency leading to chronic foetal malnutrition has been invoked by some to account for the triad of maternal hypertension or toxaemia, pathological changes or small weight of the placenta, and foetal growth retardation (Rumbolz and McGoogan, 1953; Bound, Butler and Spector, 1956; Gruenwald, 1963).

Gruenwald reported finding gross or histologic changes in the placentae of a substantial number of foetuses born at 36 to 41 weeks' gestation and having birth-weights below the mean for gestational age minus two standard deviations. He considered that these findings indicated a prolonged period of intrauterine deprivation. Similar changes were found in the placentae of some infants who exhibited wasting but little reduction in body length; here the malnourishment was presumed to have extended over days rather than weeks before birth.

Conversely, Potter (1961) from her wide experience of foetal and neonatal pathology, has found it impossible to correlate any gross or histological changes in the placenta with any characteristic changes in the infant. She points out that small and grossly infarcted placentae are not uncommonly associated with normal infants of good birth-weight.

Some cases of gross interpair differences in size and nutritional status at birth of monochorionic twins may be due to placental anastomoses through which the one twin continuously 'transfuses' the other (Benirschke, 1961). Placental anastomoses can be demonstrated frequently in monochorionic placentae but usually these produce no disturbance, both the twins maintaining separate circulations.

Perinatal Mortality

Mortality by birth weight. The infant's chance of being born alive and of surviving the neonatal period is closely related to birth-weight, as shown in Fig. 11 which was constructed from data for all births in England and Wales in 1962 (Chief Medical Officer of Health, 1963). In the lowest birth-weight group (3 lb. 4 oz./1,500 g. or less) 40 per cent of all infants were stillborn and among those liveborn only one-third survived for longer than 28 days. However, it is in the lowest birth-weight groups that improvements in survival rates are most marked. In the period 1951 to 1961 the national survival rate for liveborn infants who were between 2,001 and 2,500 g. (4·4 and 5·5 lb.) at birth improved by about 2 to 3 per cent compared with over twice this figure for infants of 2,000 g. or less. Where special intensive care units have been established the improvement is much more striking. In one Edinburgh maternity hospital (Drillien, 1958), the survival rate of babies of 3 lb. (1,360 g.) or less at birth improved from 4·5 to 28·2 per cent over a ten year period compared with an improvement from 91·6 to 96·3 per cent for those in the birth-weight range 5 to 5½ lb. (2,250 to

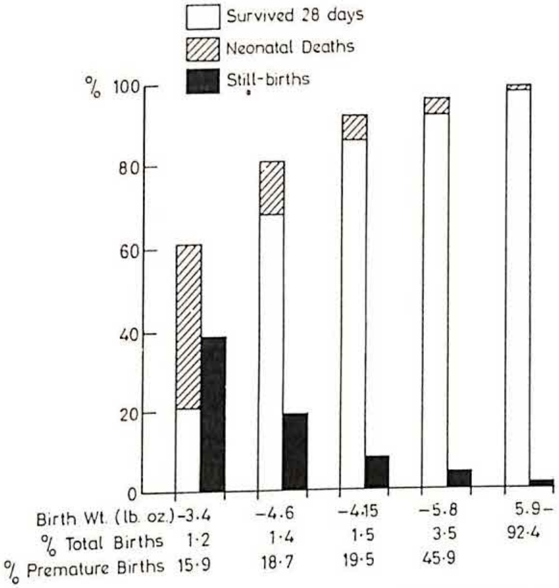

FIG. 11. Stillbirths and neonatal death rates in different birth-weight groups, based on all births in England and Wales, 1962.

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2,500 g.). Recently, Walker (1965) reported that, in the year following the opening of a special care unit in Dundee, the survival rate for liveborn infants less than 4 lb. (1,800 g.) at birth rose to 66 per cent, almost double the rate (35 per cent) obtaining in the three preceding years. Since the excess of physical and mental defect reported by many authors is confined largely to those in the lower birth-weight groups, there may well be an increase in the number of surviving children with handicaps, as facilities for intensive postnatal care of premature infants, at present concentrated in large cities, become more readily available. The efficacy of improved techniques in premature baby care must be assessed not only on survival rates but also on the physical and mental status of surviving infants.

The later experience of children of very low birth-weight (3 lb./1,360 g. or less) born in Edinburgh between 1948 and 1960 (Drillien, 1964) indicated that a high incidence of later handicap in children born in 1953–54 was related to the practice of delayed feeding current at that time. There was some evidence that delayed feeding improved the chance of survival in this low-weight group during those years, since survival rates improved steadily up to 1954 and thereafter remained at about the same level. Only in that two-year period were there more male survivors than female which suggests that these feeding practices were operative in saving those at greatest risk.

That there is a wide range in the proportion of low-weight babies showing later defect in different areas is illustrated by the study of later development of children originally enrolled in the Medical Research Council investigation of oxygen therapy and retrolental fibroplasia (McDonald, 1962). The sample comprised all infants who weighed not more than 4 lb. (1,800 g.) at birth admitted to one of 19 premature baby units between October 1951 and May 1953. After excluding cases of defective vision due to retrolental fibroplasia, which might be considered iatrogenic in origin, the proportion of children exhibiting some neurological disorder at six to eight years was 18·8 per cent of the total sample, with a range from 12 per cent to over twice that figure. Unfortunately, no data were given for survival rates or differences in postnatal care which might have explained the excess of handicapped children in some areas.

Mortality by maternal complications. The increased incidence of certain complications, particularly toxaemia and antepartum haemorrhage, in the pregnancies of women having low-weight babies has been discussed above. Both the British Perinatal Mortality Survey (Butler and Bonham, 1963) and the Edinburgh study of stillbirths and neonatal deaths (Drillien, 1947*b*), found that antepartum haemorrhage carried an increased risk to the baby independent of the effect of this complication on birth-weight or gestation period. The former survey found a similar though less marked adverse effect on the baby of toxaemia in the mother, but in the latter study babies premature by weight, born to toxaemic mothers, seemed to do rather better than those of like birth-weight born to mothers without toxaemia, whereas those mature by birth-weight born to toxaemic mothers seemed to do worse than mature infants born after uncomplicated pregnancies. There may be no contradiction in these findings. The Edinburgh babies were classified by birth-weight and those in the National Study by gestation period. Toxaemia in the mother is known to cause foetal growth retardation in some cases, and it would be interesting to know how much, if any, of the excess perinatal mortality in the offspring of toxaemic mothers in the National Survey was due to excess wastage in those who were below the expected weight for their gestational age.

Mortality by sex of infant. For all birth-weights and gestation periods, perinatal mortality (stillbirth and neonatal death) is higher for males, with the exception of a slight excess of losses in females of 1,001 to 1,500 g. (2·2 to 3·3 lb.), born between 32 and 36 weeks and most probably due to fatal malformations of the central nervous system. Apart from this group earlier gestations show the greatest preponderance of losses in males (Butler and Bonham, 1963).

A bigger excess of wastage in males was found in the Edinburgh study of hospital-born infants mentioned above (Drillien, 1947*a*) than in the national sample. These hospital confinements were restricted in the main to women having their first babies, to multiparae with a history of previous complications and to emergency admissions. Male infants, particularly if they were of low birth-weight, appeared to be more vulnerable to the extra risk of the first-born and less able to withstand the hazards of obstetric complications than female infants of like birth-weight.

Morbidity in the Pre-School Period

An increase in early illness, especially infective illness, is to be expected in children who were of low birth-weight since they tend to come from poorer homes than maturely born children. This applies more particularly to those who were in the birth-weight range 4½ to 5½ lb. (2,040 to 2,500 g.).

A prospective study in Edinburgh, of progress through the first five years of life, of children having different birth-weights (Drillien, 1964) showed that the overall incidence of medical illness at all ages was rather higher in low-weight babies, but after the age of two years differences in morbidity by birth-weight appeared to be due to differing standards of maternal care and not to birth-weight *per se*.

In the first two years of life there was a marked excess of infective illness in those of low birth-weight, both singleton and twin, and in the smallest twins as compared with singletons of similar weight. From two to four years there was not much difference by birth-weight in frequency of illness of singletons, although those twins who were 4½ lb. (2,040 g.) or less at birth continued to show a significant excess of illness as compared with singletons of like birth-weight.

In the first two years respiratory infections accounted for more than one-half of all medical illnesses necessitating medical attention. A very striking difference was found in the frequency and severity of lower respiratory infections by maternal care. The adverse effects of poor care were apparent in all birth-weight groups but were much more marked in those smallest at birth. The incidence of respiratory illness was between 20 and 30 per cent higher in boys of low birth-weight than in girls of like weight from similar types of home, but no difference was found between maturely born boys and girls.

Children who had been of low birth-weight were twice as likely to be admitted to hospital in the first two years as were the mature controls. The excess of admissions, particularly in those who were 4½ lb. (2,040 g.) or less at birth, was as noticeable when comparing those of different birth-weights receiving satisfactory maternal care as it was when comparing those receiving unsatisfactory care. The apparent increased susceptibility to lower respiratory infections of prematurely born children was also noticed by Douglas and Mogford (1953).

As would be expected, all types of minor and major congenital defects are commonly associated with low birth-weight. In particular, the incidence of visual defects, such as persisting squint and myopia, increases steadily as birth-weight decreases.

Physical Growth

Since growth in childhood is related to economic status of the home, any comparisons of physical stature and growth rates in children who were of different weight at birth must allow for the preponderance of fathers in the lower social classes in samples of low-weight babies.

In the Edinburgh prospective study of growth and development of children of different birth-weights born 1953–55 and the concurrent study of children of very low birth-weight born 1948–60 (Drillien, 1964), rates of growth of singletons and twins through the first five years were related not only to birth-weight and sex but also to other factors such as heights of parents (considered to be an indication of genetic influence) and certain social indices, particularly the standard of maternal care.

Throughout the five-year period weights of singletons were closely related to birth-weights with mean weight increments being not much different in all birth-weight groups. However, twins of good birth-weight (*i.e.* over 5½ lb./2,500 g.) showed an excess weight gain over twins smaller at birth, which increased with age.

At five years those who had been 5½ lb. (2,500 g.) or less at birth were still shorter than the mature controls, but in all groups of male and female singletons and twins, height increments in the first two years were related inversely to length at birth. This tendency for low-weight babies to catch up to some extent in height but not in weight resulted in their being not only of small stature but relatively underweight for their height at five years.

Children who had been between 4½ and 5½ lb. (2,040 and 2,500 g.) and born after 37 weeks' gestation showed the smallest gains both in weight and height and were both shorter and lighter at four years than children of like birth-weight born before 37 completed weeks. Mothers of these small full-term children were significantly shorter than mothers of children of like birth-weight but premature by gestation time.

When the standard of maternal care was taken into account more marked differences were found by birth-weight as illustrated in Fig. 12, which shows mean weights and heights at ages up to five years for those singletons and twins whose birth-weights were 4½ lb. (2,040 g.) or less at birth and over 5½ lb. (2,500 g.), from homes where maternal efficiency was considered very good and those where efficiency was only fair or poor. At five years there was a difference of about 8 lb. in weight and about 4 in. in height between mature controls receiving the best care and small prematures receiving the worst. In other words, these prematures at five years had attained little more than the average three-year weight and four-year height of the mature controls. As would be expected whatever the birth-weight, children receiving inadequate care were lighter and, to a lesser extent, shorter than those from a more favourable environment, but the effect of poor environment, particularly as regards weight, was more marked in the prematurely born. Even when maternal efficiency was considered very good the low-weight singletons and twins were still behind their controls from similar homes at five years. Where maternal efficiency was fair or poor differences were greater.

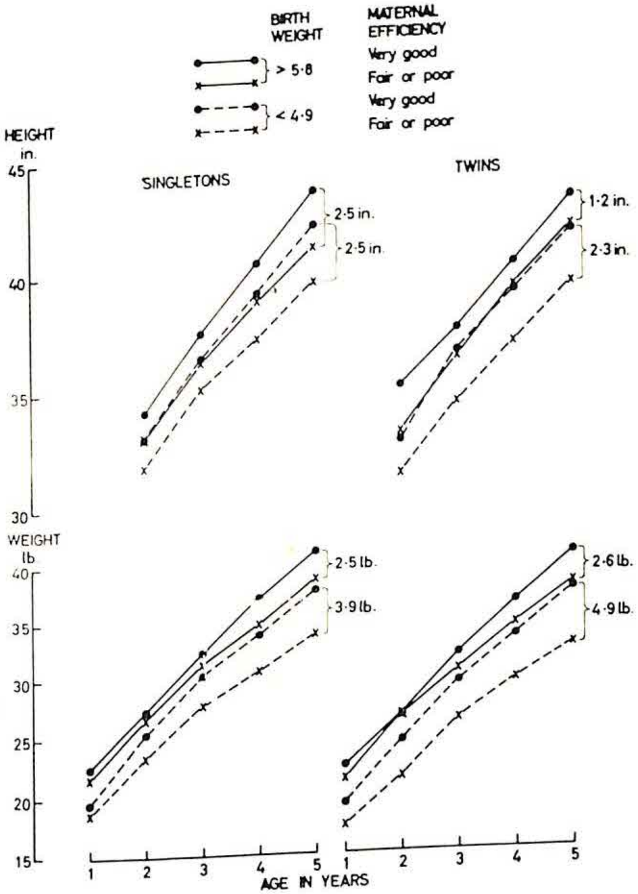

FIG. 12. Mean weights and heights at ages from one to five years for singletons and twins, of birth-weight 4½ lb. and under and over 5½ lb., receiving the best and worst standards of maternal care.

(Figs. 12, 13 and 14 reproduced by courtesy of E. & S. Livingstone, Ltd.)

More obvious stunting was observed in the group of children who were 3 lb. (1,360 g.) or less at birth. Unlike those between 3 and 4½ lb. (1,360 and 2,040 g.) at birth this group of very small prematures contained more children who were markedly short for their age than children markedly underweight. The diminutive physique at five years of many who had been of very low birth-weight could not be attributed in many cases to poor care or inadequate diet. Fig. 13 shows the proportion of premature children in three birth-weight groups who, at five years, measured less than the levels of the 5th percentiles for the mature controls (these being for males 33·5 lb./15·195 kg. and 40·6 in./103 cm.; for females 32·2 lb./14·605 kg. and 40·0 in./102 cm.). The number of children who were very undersized for their age increased with decreasing birth-weight within the group weighing $5\frac{1}{2}$ lb. (2,500 g.) or less at birth, and was more obvious in twins than in singletons.

Lubchenco and her colleagues (1963*b*) reported on the physical growth at ten years of prematurely born children of birth-weight 1,500 g. (3 lb. 4 oz.) or less.

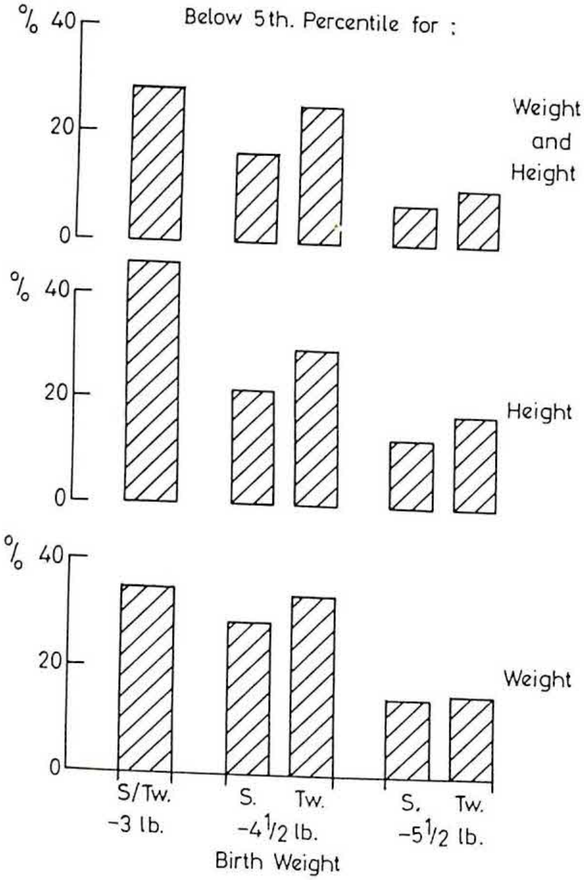

FIG. 13. Proportions of low birth-weight infants (singleton and twin) markedly undersized at five years, by weight at birth.

At birth and at ten years 20 per cent of the premature sample were at or above the 50th percentile of expected weight for gestational age. The proportion weighing less than the level of the 10th percentile increased from 22 per cent at birth to 42 per cent at ten years. Infants who at birth were small for their gestational age tended to remain small throughout the pre-pubertal period. Marked growth retardation at ten years was commonly found in those suffering from mental backwardness or a severe degree of cerebral diplegia, whether or not they had shown foetal growth retardation.

A study of 16 twin pairs, who had exhibited quite marked interpair differences in birth-weight, provided an opportunity for evaluating the later effects of foetal growth on physical stature with the influence on growth of environmental and genetic factors reduced to a minimum (Babson *et al.*, 1964). Highly significant differences were still apparent between the larger twins and the smaller at ages 4½ to 11 years. Retardation in height of the smaller twins tended to be rather greater than retardation in weight. Bigger interpair differences were noted in monozygotic twins but in four of the nine monozygotic pairs the twin smaller at birth had major congenital anomalies while the co-twin had no defects.

In experiments using suckling rats (Widdowson and Kennedy, 1962; Widdowson and McCance, 1960) it was demonstrated that the effects of differential food intakes during suckling persisted throughout life, those who were small at three weeks remained small in spite of unlimited food being available thereafter. However, in the human twin sample quoted above, there was little evidence of neonatal malnutrition. Rather surprisingly, the smaller twins on average had a smaller relative weight loss postnatally than did the larger twins. Discussing other animal experiments, McCance (1962) wrote 'the failure of a young animal to catch up with its fellows or litter mates for a long time and indeed its tendency at first to lag further and further behind after a nutritional setback before birth, is a common experience in many species'. It seems likely that growth retardation in later childhood of twins who have suffered foetal growth retardation is a further example of this phenomenon.

Mental Development and Neurological Status

Of the many published studies of later development of low birth-weight babies, the majority have been concerned, not unnaturally, with intellectual ability and the incidence of neurological defects. Wallich and Fruhinsholz (1911) reviewed the early literature, and Benton (1940) dealt in some detail with studies published between 1910 and 1940 which concentrated on mental development, neurological status and personality characteristics of prematures. Another useful review by Wiener (1962) summarises the later studies by American, British, and French workers.

Of the more important investigations reported in recent years, the most comprehensive from the viewpoint of sample selection and also notable for its successful follow-up over a long period, is the study of low-weight babies born during the National Maternity Survey of 1946 (Royal College of Obstetricians and Gynaecologists and the Population Investigation Committee, 1948). The sample was selected from all live-born infants of birth-weight 5½ lb. (2,500 g.) or less born in the first week of March 1946 and has been followed up to fifteen years, together with a group of control children matched by various social indices. At eight years over 80 per cent and at eleven years 71 per cent of surviving National Survey children in Primary Schools completed a series of standardised tests of intelligence and educational attainment (Douglas, 1956, 1960). Children ineducable in normal school were not included; 7 per cent of the total remaining in the survey at eleven years were excluded for this reason. Small but statistically significant differences were found between the mean test score results of prematures and controls at eight years and at eleven years rather bigger differences were observed; moreover, at this age only 9·7 per cent of prematures gained entry to Grammar School compared with 22·0 per cent of controls. Douglas concluded that, apart from a small, well-defined group who were heavily handicapped, other differences between prematures and matched controls were explainable on the grounds of environmental disadvantages which remained unrecognised until the children reached eleven years. One would not expect to find big differences between prematures and controls in Douglas's sample since over one-half were in the birth-weight range 5 to 5½ lb. (2,250 to 2,500 g.) and only 9 per cent were 4 lb. (1,800 g.) or less. Even so, further examination of the results of intelligence testing at eleven years reveals that there were nearly twice as many above average children in the control group and less than one-half the number of retarded children, differences unlikely to be entirely explained by the rather minor differences in environment described.

Prospective studies from Baltimore (Knobloch *et al.*, 1956; Harper, Fischer and Rider, 1959); New York (Freedman, 1961, 1962; Heimer, Cutler and Freedman, 1964) and Edinburgh (Drillien, 1964) attempted to equalise more nearly numbers in different birth-weight groups in the samples selected, allowing distinctions to be made between the larger prematures, many of whom would be small babies born at or near term, and the smaller infants who are more likely to be premature both by birth-weight and gestation period.

In the Baltimore study the incidence of mental and neurological defect detected at 40 weeks was nearly four times as high in those with a birth-weight of 1,500 g. (3·3 lb.) as in a control group. The differences between small prematures and matures increased between 40 weeks and re-examination at three to five years, though at this later age little difference was found between those who had been between 2,001 and 2,500 g. (4·4 and 5·5 lb.) at birth and the mature controls. A similar increase in incidence of neurological defect with decreasing birth-weight was found in the group of mainly Negro children studied in New York. In addition, a significantly higher incidence of neurological abnormality was found among male infants of low birth-weight than among female in this study.

In Edinburgh, groups of hospital born infants of different birth-weights were studied from birth to seven years (Drillien, 1964). Scores on developmental testing in the pre-school period and on intelligence testing (T.M.L. scale) in school fell steadily with decreasing birth-weight, twins showing consistently lower scores than singletons of like birth-weight at all ages. Intellectual ability was related to socio-economic status, but in all social groupings those who had been 4½ lb. (2,040 g.) or less at birth were at a disadvantage compared with mature controls from similar homes. There was little difference in mental ability between those who were over 4½ lb. at birth and the controls (Fig. 14). The incidence of mental retardation and/or neurological abnormality of sufficient severity to necessitate special education increased from 2 per cent of those over 5½ lb. (2,500 g.) at birth to 49 per cent of those who were 3½ lb. (1,590 g.) or less.

Defects of sight and hearing, epilepsy and cerebral diplegia were commonly associated with birth-weights of 4½ lb. (2,040 g.) or less.

A number of studies have concentrated on the later development of babies of very low birth-weight, who appear to be at the greatest risk of subsequent handicap. McDonald (1962) traced after an interval of six to eight years all but 3 per cent of surviving children who had been enrolled originally in the Medical

Research Council investigation of oxygen therapy and retrolental fibroplasia, between 1951 and 1953. Some neurological or ophthalmological disorder was found in nearly one-quarter. In addition, one-half of the survey children who had died were known to have had a neurological disorder.

A study of prematurely born children with birth-weights of 1,500 g. (3·3 lb.) or less from Denver, Colorado (Lubchenco *et al.*, 1963*b*) showed that at ten years two-thirds of the total exhibited some visual or central nervous system defect, although one-half of the defects reported were not seriously crippling. Educational difficulties were reported for one-third of those children who were of normal intelligence. The incidence and severity of handicap was again inversely related to birth-weight.

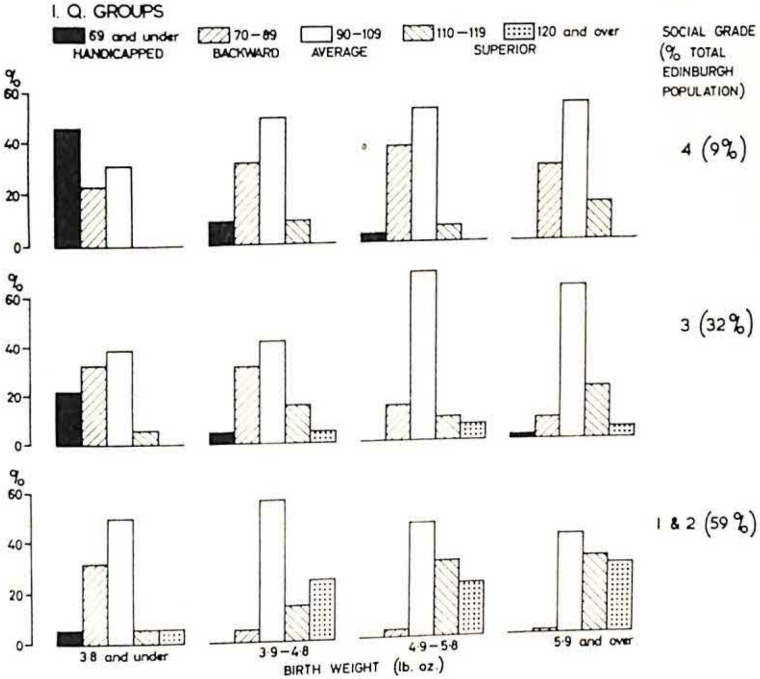

FIG. 14. Effect of birth-weight and environment on intellectual ability at age five to seven years. (Social Grade I—middle class; Grade II—superior working class; Grade III—average; Grade IV—poor).

A similar high incidence of later handicap exhibited by infants of very low birth-weight (1,250 g./2·75 lb. or less) was reported from Warsaw (Janus-Kukulska and Lis, 1966). At three to twelve years 32 of a group of 65 children were considered to be mentally retarded. Eye defects were found in one-third and other neurological abnormalities in one-quarter.

A much lower incidence of later handicap was reported for a sample of children with birth-weights or minimum postnatal weights of 1,000 g. (2·2 lb.) or less (Dann, Levine and New, 1958, 1964). However, since the incidence of mental retardation was known to be much higher in those children not returning for re-examination (45 per cent of the total), this more optimistic report about later development of very small premature infants must be treated with some reserve.

In the study of 16 pairs of twins of dissimilar size at birth (Babson *et al.*, 1964), significant differences were found (favouring the larger twin) in intelligence and in the judged level of language comprehension and expression in both monozygotic and dyzygotic pairs.

In Edinburgh, 72 of a total of 110 children of birth-weight 3 lb. (1,360 g.) or less have passed the age of five years (Drillien, 1964). Over one-third of the school age children are ineducable in normal school for reason of physical or mental handicap or both; over one-third are in normal school but are educationally retarded; and less than one-third are doing class work appropriate to their age. Some congenital defect and/or mental retardation was found in three-quarters. Of 51 children with siblings for comparison, 76 per cent were considered to be of poorer ability than any of their larger born siblings.

From the studies quoted above, there appears to be general agreement that children with birth-weights above 2,000 g. (4·4 lb.) do not show any marked impairment in mental ability compared with maturely born children from similar homes. Below this weight there appears to be a steady increase in incidence of mental retardation and neurological defect as birth-weight decreases and this cannot be accounted for solely by impoverished environment. Although the reported incidence of serious handicap in babies of very low birth-weight varies in different centres, there seems little doubt that a substantial proportion of these infants exhibit a variety of physical and mental handicaps.

The demonstration of an increased incidence of mental and neurological defect in children of low birth-weight raises the question as to what is the primary cause of such defect. If the premature birth itself is the cause, either because the infant is deprived of a period of intrauterine environment essential to final maturation of the nervous system (as suggested by Polani, 1959), or because of hypoxic birth injury from complications associated with the premature delivery, improvements in antenatal and obstetric care and in the techniques of premature baby care might be expected to improve the chance of later normality. On the other hand, if the baby is born prematurely because of developmental defect already present such improved techniques might lead to the survival of an increasing number of defective children.

McDonald (1964*a*) observed that cyanotic attacks were closely associated with cerebral diplegia in small premature infants and also that the prevalence of diplegia appeared to be uninfluenced by abnormalities of pregnancy and delivery and was similar whether the premature birth had occurred spontaneously or had been induced on account of severe complications. She concluded that cerebral diplegia in these infants was likely to be postnatal in origin and due to oxygen deprivation in the early neonatal period. An equally feasible explanation would be that more than one causative factor was operating in the group of small prematures who later exhibited the clinical picture of diplegia. Spontaneous premature birth and subsequent cyanotic attacks could both be due to underlying developmental abnormality. In other cases where premature birth was due to surgical interference on account of pregnancy complications, the same clinical picture could have been caused by intrauterine hypoxia. It would have been illuminating to have been told if there was any difference in the incidence of associated developmental anomalies between the spontaneous and induced premature diplegics.

In the Edinburgh series of very low birth-weight babies the number of associated anomalies, which must have arisen at an early stage of foetal development, would support the hypothesis that in many cases both premature delivery and subsequent defect were due either to an underlying developmental abnormality in the foetus or to another factor producing both prematurity and defect. In the larger series of Edinburgh children of all birth-weights followed up to seven years, there was a much higher incidence of complications during pregnancy or at birth reported for those of low birth-weight than for the mature controls, but there was not much difference in the incidence of complications in the perinatal histories of low-weight babies with mental or neurological handicap and those of like birth-weight without handicap. Similarly, in the New York Study (Cutler *et al.*, 1965) no clear relationship was apparent between prenatal complications and neurological abnormalities, apart from the effect of complications on birth-weight and gestation period.

It may be that some foetuses are more vulnerable than others to perinatal hypoxia or that complications before, during or after birth may constitute an added insult to an already damaged central nervous system. Certainly, there would appear to be other aetiological factors involved which determine the outcome in babies of low birth-weight, since, even in the lowest weight-groups whether or not premature delivery had been associated with severe obstetric complications, some children show no evidence of any defect at later ages and are no different from their siblings in mental ability, whilst others exhibit a wide variety of physical, neurological, and mental handicaps.

Behaviour Disturbances

Many of the studies mentioned in the previous section report an excess of behaviour problems and personality aberrations of many different types in those of low birth-weight (*e.g.* Douglas, 1960; Knobloch and Pasamanick, 1962; Lubchenco *et al.*, 1963*b*; Wortis *et al.*, 1964; Janus-Kukulska and Lis, 1966). The varieties of behaviour disturbance described by different authors cover a wide range from nail-biting, nightmares and masturbation to nervousness, overdependence and temper tantrums. No typical pattern of disturbed behaviour emerges from a study of the literature except that most observers make mention of hyperactive, restless behaviour, particularly in those of very low birth-weight. Over one-half of the children studied in Warsaw exhibited this type of behaviour.

A number of possible explanations come to mind to account for behaviour disturbance in those who were of low birth-weight. It could be that the reported excess is more apparent than real, since few investigators have compared children of different birth-weights but similar upbringing and early life experiences. Since low-weight babies are more likely to come under regular supervision and observation, reports of behaviour aberrations are more likely to be made about them than about those who have no particular reason for being observed. However, assuming that the reported excess of behaviour disturbance is a true phenomenon, the following are possible explanations:

(1) Since low birth-weight is associated with poor socio-economic background, these children are more likely to be subjected to stressful family situations.

However, it is in the smallest prematures that the most marked excess of disturbed behaviour is found and, here, the association of low birth-weight with poor social class is not as marked as it is for those of birth-weight 4½ to 5½ lb. (2,040 to 2,500 g.).

(2) Particularly in the first few months of life, experiences of the small prematurely-born infant will differ from those of the normal full-term baby. It is unlikely that he will be breast fed. He may suffer total separation from the mother by being nursed in an incubator. He will be kept in the hospital nursery for an extended period after his mother has returned home. After his discharge from maternity hospital he is more likely to require later hospitalisation and suffer from further separations, particularly as a result of his increased susceptibility to lower respiratory infections.

(3) The mother's responses to the baby and her handling when she gets him home may be different from those of a mother whose baby has caused no anxiety postnatally. The mother of a small baby may be tense and anxious and have feelings of inadequacy, possibly exacerbated by what she has seen of the paraphernalia accompanying current techniques of premature baby care. Feeding and other difficulties of management may result in her obtaining little pleasure from her baby in the early months.

(4) There is the further possibility that the behaviour disturbances may have an organic basis and may be due to minimal brain damage resulting either from the prematurity itself or from the commonly associated perinatal complications.

It would appear that the most reliable method of assessing the effect on later behaviour of birth-weight, obstetric complications, maternal handling and early environment, would be to follow a group of children from birth onwards. This was attempted in the Edinburgh longitudinal study of children of all birth-weights, whose behaviour was observed in the homes during the pre-school period and in school by class teachers, using a standard assessment of behaviour (The Bristol Social Adjustment Guide: Stott and Sykes, 1956) at the age of seven years.

In the pre-school period the incidence of all types of problems increased in all birth-weight groups when maternal handling was obviously unsatisfactory. In general, there was more mishandling of low-weight children, due mainly to over-anxious, over-protective maternal attitudes. This accounted in the main for the excess of pre-school problems observed in those who had been of low birth-weight. However, when birth-weight had been 4½ lb. (2,040 g.) or less, there was a small increase in the incidence of severe behaviour disturbance independent of adverse handling or environmental disadvantages. No independent effect could be attributed to feeding difficulties or short periods of separation due to hospitalisation.

The association of disturbed behaviour with low birth-weight was more obvious at early school age, as shown in Fig. 15. In all types of home there was more disturbed behaviour in children who had been of low birth-weight and for all birth-weights disturbance increased with declining social standards.

An additional hazard to babies of low birth-weight is their increased risk of suffering intrauterine hypoxia or trauma at birth. The incidence of behaviour disturbance in school was raised in all birth-weight groups when there had been a history of complications or pregnancy and/or delivery, disturbed behaviour increasing with the severity of obstetric complications. Severe obstetric complications appeared to lower the resistance level to early familial stress, particularly in males, twins and those who were 4½ lb. (2,040 g.) or less at birth.

A study of 73 twin pairs included in the sample provided further evidence of the effect of sex, birth-weight and the birth process on later behaviour. The smallest members of like sex twin pairs showed more disturbed behaviour, particularly if they were second-born. In twins of unlike sex the male members showed more adverse behaviour but only significantly when they were also second-born. In 21 of the twin pairs there was a marked difference in behaviour of the two twins in school. In all but three instances the more disturbed twin had been second-born and/or subjected to a more traumatic delivery.

Prechtl (1960) reported finding an excess of behaviour problems at two to four years in maturely born children following obstetric complications, particularly in those who had exhibited minor neurological abnormalities in the neonatal period. Both Prechtl (1961) and Knobloch and Pasamanick (1962) have suggested that tension in the mother may be produced initially by early difficulties in the infant rather than *vice versa*.

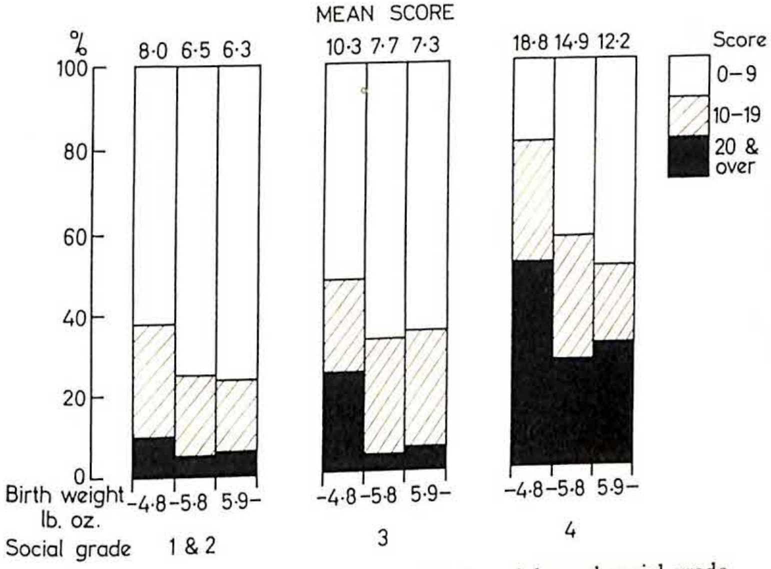

FIG. 15. Behavioural assessments by birth-weight and social grade.

Among Edinburgh children of birth-weight 3 lb. (1,360 g.) or less, 70 per cent were said to show behaviour disturbance in school; nearly one-half showed marked restlessness and over-activity. This type of behaviour occurred at all intelligence levels and was thought to account for the slow educational progress of some children of average ability.

In the field of behaviour as in his health history, physical growth and mental development, the baby with a birth-weight of less than 4½ lb. is likely to suffer from multiple disadvantages. Compared with the maturely born child he is more likely to have experienced perinatal complications, to receive inadequate physical care, to be subjected to adverse maternal handling and to be brought up in an unstable environment. In addition, in all areas of physical, mental and emotional development, low birth-weight appears to be significantly associated with a lowered resistance to the effects of these adverse peri- and postnatal experiences.

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Chapter 5

NUTRITION AND FEEDING

ALTHOUGH in most Western countries digestive and nutritional disorders are now much less important causes of death in infancy and ill-health in childhood than during the earlier part of the century, the proper feeding of infants and children remains one of the major concerns of those responsible for child health. The reduction of these disorders has been due, on the one hand, to improved economic conditions and hygiene, the provision of clean milk, raised standards of domestic cleanliness and mothercraft, and on the other hand to a more realistic consideration of the needs of the individual child as opposed to rule-of-thumb methods of feeding. The aims of successful feeding may be summarised as follows. The infant should be encouraged to establish a feeding régime which will satisfy his hunger and avoid frustration, and this in turn should lead to healthy appetite throughout childhood. The diet should be adequate in total calories, fluid content, and bulk, and should cover the nutritional requirements in essential constituents. But when these requirements are covered, the child should be allowed a wide measure of choice. The diet should be palatable and properly cooked. Digestion should be allowed to take place with a minimum of disturbance. Regular bowel action should be established and maintained without the use of laxatives as the stools become formed.

Improved nutrition has certainly been one, if not the sole, factor responsible for the acceleration of growth and maturation of children which has occurred in countries with a high standard of living during the present century (Wolff, 1955). It is probable, however, that the pendulum has swung too far in the direction of overnutrition amongst the most privileged populations at a time when malnutrition is still a major problem for nearly half the world. The very early introduction of soft solids into the infant's diet and the high pressure advertising of sweets, proprietary foods, drinks, ice-cream, vitamin preparations, etc. through all available mass media, require much more critical evaluation in terms of child health and fitness in adult life than they commonly receive (Forbes, 1957). Thus the largely unregulated fortification of infant foods with vitamin D was found at one time to have produced the situation in which a toddler might well be getting 4,000 units daily (ten times the minimum requirement) and in cross-sectional samples of Boston schoolchildren Johnson *et al.* (1956) found that more than 10 per cent of the children were regarded as overweight. The excessive use of refined sugar is not only a nutritional hazard, but is also an important factor in producing dental caries. Whilst the elimination of disease due to nutritional deficiency from infant and childhood communities is wholly desirable, it may reasonably be assumed that there is an optimum nutritional status which it is not advantageous to exceed.

Appetite

It has been shown experimentally (Brobeck, 1957) that appetite is under the control of twin centres laterally placed in the hypothalamus, and satiety, or inhibition of appetite, by similar centres situated medially. The appetite centres are activated by a variety of stimuli, *e.g.* hunger contractions of the stomach (see below), hypoglycaemia, and possibly cold. When food is taken, the satiety centres are stimulated and appetite is inhibited, *i.e.* a sensation of repletion is experienced. This alternating mechanism is commonly well adjusted to the requirement of growth and activity, though it may become disturbed by psychological upsets, physical disease, or inability to satisfy the appetite. Thus unrelieved hunger or malnutrition will tend to inhibit appetite rather than increase it. It is probable also that consistent neglect of the sensation of repletion will raise the threshold at which this is experienced and produce a vicious cycle of over-eating, increased appetite, and over-eating. Since the young infant is almost wholly dependent on the food offered, natural appetite can be disturbed by either under-feeding or compulsive feeding, or by lack of opportunity for selection.

Mechanical Factors in Digestion

The digestive tract of the infant differs in several respects from that of the older child, and its capacity is correspondingly limited. The absence of teeth excludes the chewing of solid food, and although saliva is excreted at birth, salivary digestion in early infancy is negligible. Liquid food in the form of milk is normally obtained by sucking, a reflex act at first consisting of regular and co-ordinated movement of the jaws (later associated with inspiration), and controlled by a centre in the medulla. This reflex begins to disappear in the latter part of the first year. Swallowing also occurs as a reflex act, and is stimulated when sufficient milk has been ingested to flood the floor of the mouth and reach the uvula. It is known that in later life the act of swallowing causes a reflex inhibition of respiration, and whilst the same is probably true in the infant, the regularity of the swallowing during feeding causes less obvious disturbance of respiratory rhythm. Swallowing usually bears a 1:1 or 2:1 ratio to the respiratory cycle, being followed regularly either by inspiration or expiration, or alternatively by first one and then the other (Wolman, 1944).

The stomach at birth and during early infancy lies with its long axis placed transversely, and only gradually reaches the adult form and position at the age of about eleven years. Its capacity and shape are extremely variable, depending not only on food-intake but also on air-swallowing.

When the stomach is filled, there is tonic contraction of the fundus around the food. Waves of contraction are rapidly stimulated. These first originate near the pylorus and subsequently at the cardiac end of the stomach, passing towards the pylorus. The findings in the newborn, however, are not consistent and Smith (1959) considers that there is unpredictable relaxation of the pylorus and 'massive, gentle, non-peristaltic movement' associated with emptying of the stomach. When the food is entirely fluid in early infancy, the stomach begins to empty more rapidly than in the adult; radiological studies have shown that the meal may begin to pass the pylorus within five minutes, but again in the newborn complete emptying may be delayed for more than eight hours.

It should be emphasised that the rate of emptying of the stomach varies considerably in different infants, and that hunger will occur sooner after a feed in one than in another. The emptying time is also found to vary with position (being longest when the infant is lying on his back), and with the composition of the feed, breast-milk usually being evacuated more rapidly than an artificial feed. Emotional factors and parenteral disease may also profoundly modify gastric motility; these will usually tend to reduce motility, delay the emptying time, and so diminish appetite, whilst if the disturbance is severe, vomiting may be initiated.

'*Hunger contractions*' and increased tonus of the stomach occur when the stomach is empty. They are more frequent and intense, and occur sooner in the infant than in the adult, appearing at intervals of ten to fifteen minutes (Carlson and Ginsburg, 1951), or even at intervals of less than five minutes in the newborn (Taylor, 1917). Taylor gave the average interval between feeding and the next hunger period in the newborn full-term infant as two hours fifty minutes, with a maximum of four hours and a minimum of two hours, as compared with an average of three hours fifty minutes in infants aged two weeks to four months. The recognition of the physiological basis, variability, and intensity of hunger in the infant is essential for rational infant feeding.

In older children, the interval between taking food and the appearance of hunger contractions is longer. The influence of psychological factors on appetite is well known, but it should be remembered from the physiological aspect that for a healthy appetite to develop, the stomach must be given a reasonable time to empty after a meal. An excess of fat in the diet will also tend to delay gastric emptying, and so reduce appetite.

Air-swallowing is a normal procedure in the infant, and Bouslog *et al.* (1935) showed radiologically that air might enter the stomach with the first inspiration. Some degree of air-swallowing always occurs during feeding, and if not excessive, the gas-bubble rises to the fundus of the stomach and is eructated by the infant during or after the feed. This is facilitated by holding the baby erect after the feed until eructation has occurred. If the infant is placed on its left side immediately after feeding, the air tends to fill the pyloric end of the stomach, and to pass through the pylorus with the food; this gives rise to distension of the small bowel and discomfort. The management of air-swallowing in infant feeding is considered subsequently.

The small intestine is 300 to 350 cm. in length at birth (Scammon, 1923), approximately 450 cm. at one year, and 600 to 700 cm. at puberty. In the infant, the first part of the duodenum when filled has the appearance of a straight horizontal tube (Wolman, 1944), later assuming the adult form. Movement in the small intestine in childhood is thought to be similar to that described in the adult, but, as in the case of the stomach, the intestinal movement of the young child is much more susceptible to outside influences. Apart from the movement of the villi, which serves to empty the central lacteals and facilitate absorption, three types of movement have been described: rhythmic segmentation, pendulum or swaying movements, and 'travel wave' or 'peristaltic rush'. The last of these is particularly readily excited in infants and young children, with the result that diarrhoea may follow such different stimuli as fright, infection, or even the taking of food. Lipolytic activity in the duodenum is relatively low, particularly during the first year of life.

The large intestine is relatively more capacious in the infant than in the adult, and owing to the more liquid character of the food, probably plays a more important role in the absorption of fluid. Apart from this, digestion is completed by the time the intestinal contents pass the ileo-colic sphincter.

Defaecation. This is a reflex act which is not under voluntary control in early infancy, when it commonly occurs three or more times a day, or even after each feed. Sphincter control is not acquired until the stools are becoming formed, and since voluntary control is necessarily established gradually, it is understandable that it is less perfect, and less well able to withstand every sea of troubles, in young children than in adult life.

When control is firmly established, most children adopt a defaecatory rhythm of one bowel action a day at approximately the same hour, but either a more or a less frequent rhythm is quite consistent with perfect health. 'Constipation' and 'diarrhoea' should be judged not by the frequency of bowel actions (unless there is a sudden interference with the child's normal rhythm) so much as by the consistency of the stools.

Stools. At birth the gut contains meconium, which is semi-fluid, viscid, and dark green in colour. There is wide variation in viscosity, water-content, nitrogen and tryptic activity (Emery, 1954). The colour is due to the presence of bile pigments (the meconium being clay-coloured in infants born with congenital obliteration of the bile-ducts). The material consists of swallowed amniotic fluid, desquamated cells, and the digestive secretions; in the absence of trypsin (in fibrocystic disease of the pancreas) the meconium may have the consistency of putty and cause ileus. Meconium is practically odourless and whilst it may be sterile at birth, organisms rapidly appear during the first twenty-four hours.

After the fourth day of life, the stools gradually change to the consistency and yellowish colour of custard, which they maintain for the first four or five months. They are slightly greasy, owing to the relatively high fat content (approximately 35 to 40 per cent of the dried stool), and have a sour smell; they lack the faecal odour of the stools in later life, which is due to the presence of indol and skatol and to the action of putrefactive bacteria in the large gut. The infant's stool normally contains 85 per cent water, only very small amounts of protein, and no sugar. Approximately 10 per cent of the dried stool consists of mineral matter. The presence of undigested curds is an indication that the food is passing too rapidly, or that the cow's milk curd is proving too tough for the digestive enzymes.

The reaction of the stool in the case of breast-fed babies is acid, but in artificially fed infants it is usually neutral or faintly alkaline, though the exact composition of the feed may result in some variation in reaction, *e.g.* the addition of lactose tending to produce an acid stool. This difference in reaction is thought to be at least partly responsible for the difference in flora of the breast-fed and artificially fed infant's stool.

The stools become darker in colour during the second six months of life, and after eight months may be becoming formed; in the case of many normal infants, however, the stools are not formed until the second year. They then assume the colour and odour of the adult stool.

Intestinal flora. The rapid appearance of organisms in the meconium after birth is partly due to invasion from below, but principally to organisms being ingested by mouth before food is taken. The upper part of the small intestine remains relatively free from organisms for a longer time in the breast-fed than in the artificially fed infant, possibly due to the higher gastric acidity in the former. There is also a striking difference between the character of the faecal flora of the breast-fed and that of the artificially fed infant, and it has been suggested that this may have a bearing on the relative freedom from gastro-intestinal upsets observed in breast-fed babies. Tissier (1900) showed that during the period of breast-feeding, the infant's stools are characterised by an almost pure growth of *B. bifidus*, but that this organism tends to disappear with the change to a mixed diet. Artificially fed infants, however, show a mixed faecal flora throughout, including *B. acidophilus*, an organism similar to, but not identical with, *B. bifidus*. During later infancy, the flora gradually changes to the mixed adult type. The presence of strains of atypical *E. coli* and their relationship to infantile gastro-enteritis have recently received much attention; these cannot be regarded as part of the normal flora.

Nutritional Requirements

Calories.* When it is considered that the infant may double, or more than double, his birth-weight in the first five months of life, it will be realised that his caloric requirements will be relatively much higher than those of an adult. They are normally supplied by approximately 50 cals. per lb. (110 per kg.) body-weight per day during the first six months and by 45 per lb. (100 per kg.) during the second, as compared with the needs of a man weighing 154 lb. (70 kg.) on moderately active work who requires 3,000 cals., *i.e.* approximately 20 cals. per lb. (43 per kg.). Throughout childhood the caloric requirements remain high, in order to supply the calls of both growth and energy.

Individual variations, however, are so wide, particularly at the approach of puberty, that the following recommended allowances (B.M.A., 1950) can only be taken as an approximate guide in planning the feeding of large numbers: at one year 1,150 cals.; at four years, 1,400 cals.; six to eight years, 1,700 to 1,900 cals.; at ten years, 2,250 cals. and at twelve years, 2,650 cals. At fifteen years, the requirements have been estimated as 2,600 cals. for girls and 3,400 cals. for boys, but in the early teens the individual requirements will be conditioned very largely by the age of occurrence of the pubertal spurt of growth.

Fluid. The infant requires approximately 2½ fl. oz. per lb. body-weight per day (156 ml. per kg.), though in the newborn period the requirements are slightly less. In older infants and children, temperature and activity will cause great variation. Whilst thirst is usually a reliable guide, it is sometimes found that a child who is constipated, with dry hard stools, is suffering from excessive fluid absorption in the large bowel and that the conditions can be relieved by a higher fluid intake. It has been estimated (Blackfan *et al.*, 1933) that average fluid requirements are 120 to 125 ml. per kg. per day at one year, 100 to 110 ml. at four years, and 50 to 60 ml. at fourteen years.

Protein, fat and carbohydrate. Whilst fat and carbohydrate are the main sources of energy, and are to some extent interchangeable in metabolism, protein is essential for growth and the replacement of protein breakdown which is continually going on in the tissues of the body. Protein cannot be entirely manufactured from fat and carbohydrate, and the food must therefore contain sufficient suitable protein to supply the amino-acids essential for growth and maintenance.

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* The large Calorie used in dietetics to express energy represents the amount of heat required to raise 1 litre of water from 15° to 16° C., and is a thousand times greater than the small calorie used in physics.

The *protein* requirements of the infant cannot be accurately assessed in terms of total protein, since the biological value of different proteins varies considerably. Thus the breast-fed baby thrives on only 1·8 to 2·3 g. total protein per kg. per day (representing less than 10 per cent of total calories), whereas babies artificially fed on cow's milk formulae may show deficiency symptoms if the total protein falls below 2·6 to 3·5 g. per kg. body-weight per day, representing 12 per cent of total calories (Blackfan *et al.*, 1933).

In the diets of healthy normal children, it is found that protein usually represents at least 10 per cent of total calories, though this is probably more than double the minimum requirements of first-class protein in childhood. The daily allowances of protein for children recommended by the B.M.A. Committee (1950) are

2 to 6 years	56 g.
7 to 10 years	74 g.
11 to 14 years	102 g.

The inclusion of ½ to 1 pint of milk daily in the diet of children, together with the amounts of meat, cheese, eggs, or fish normally eaten, will provide an ample supply of first-class protein. In countries where animal protein is not normally included in the staple diet, it is of much greater importance that the vegetable protein consumed should be of high biological value. A full discussion of plant proteins in child feeding is given by Dean (1953), and it has been shown by Widdowson and McCance (1954) that diets in which only 4 per cent of the calories were derived from milk and other animal foods, 75 per cent from bread, and 21 per cent from vegetables, provided under-nourished children aged five to fifteen years with all necessary nutrients required for satisfactory growth and development over a period of eighteen months.

Carbohydrate is the main source of glucose; the latter circulates in the blood, providing for energy requirements, and is stored in the liver as glycogen. Owing to the rapid metabolism of childhood, the calls for rapidly assimilable carbohydrate are higher than in the adult, and the craving of children for sweet or starchy foods is physiological within limits, though liable to become excessive if over-indulged. If young children are kept for several hours without carbohydrate they may develop symptoms of hypoglycaemia. Carbohydrate deprivation may also be associated with the occurrence of ketosis. Ketone bodies, the intermediary products of breakdown of fat, appear in the blood and urine when the liver is unable to cope with excessive demands for fat metabolism such as occur during carbohydrate starvation. Ketosis occurs most readily in early life, owing to the immaturity of the liver and to the high demands for available glucose which tend to cause rapid depletion of liver glycogen.

A too-exclusively carbohydrate diet, however, tends to produce fat rather than muscular development (see Infant Feeding, and the use of sweetened condensed milk).

The minimum carbohydrate requirements have been estimated as 3 g. per kg. per day for infants and 2·5 to 3 g. in the case of older children; the normal intake, however, of the healthy child is considerably higher (10 to 14 g. for infants and 8 to 10 g. for older children). Although the carbohydrate present in milk is lactose, artificially fed infants are able to digest other sugars such as cane sugar and dextrimaltose, and the employment of lactose in the artificial feeding of infants is not necessary. Lactose has, however, the slight advantage that it is less sweet than other sugars, whilst the effect on the stools has already been considered. It is possible also that some amount of lactose is necessary in the infant's diet for the synthesis of the galactolipins of the central nervous system.

Fat is, weight for weight, the most fruitful source of energy, *i.e.* 9 cals. per g. compared with 4 cals. per g. in the case of protein and carbohydrate, and certain fats, *e.g.* fish-liver oils supply the fat-soluble vitamins. Human milk and cow's milk both contain 3·5 to 4 per cent fat (the percentage varying considerably in different samples), yielding approximately half of the total calories. Jersey and Guernsey milks having a higher fat content should be avoided in the artificial feeding of young infants. In general, it is found that a high fat intake is often not well tolerated in early childhood, and is liable to result in ketosis and in indigestion (probably related to the effect of fat in causing gastric and intestinal inertia).

Inorganic elements. The inorganic elements required in diet are iron and iodine (for the formation of haemoglobin and thyroxin respectively); calcium, sodium and potassium; phosphorus, sulphur, and chlorine; and other elements including copper, cobalt, zinc and manganese (Underwood, 1956) in minute traces.

Iron is an essential constituent of all tissues, and must be supplied in the diet to provide for growth of the whole organism, and especially for that of the haemopoietic tissues. Gairdner (1958) gives average values of body iron at birth: total iron 74 mg. per kg., made up of 57 mg. per kg. haemoglobin iron, 7 mg. per kg. tissue iron, and 10 mg. as storage in iron in the liver and spleen, the last being the most variable. Failing an adequate iron intake after birth, iron deficiency anaemia is likely to occur during the second six months of life. The estimated daily iron allowances (N.R.C.) are 6 mg. up to one year, 7 mg. at one to three years, and 12 mg. at ten to twelve years. There is usually no gross iron deficiency in a full-term infant on a milk diet up to the age of three or four months, but after this time it is important that iron-containing foods, such as bone and vegetable broth, should be added to the diet. The iron content of both human and cow's milk is very variable, *e.g.* 0·03 mg. to 0·19 mg. per 100 ml. in human and 0·062 to 0·24 mg. per 100 ml. in cow's milk (Clements, 1949), and a breast-fed infant of three months may be getting less than 1 mg. of iron daily from the milk. Premature infants will require early supplements of iron, since although the haemoglobin level and concentration of iron in the tissues and liver at birth are similar to that of the full-term infant, the *total* iron in the body may be very much less (depending on the birth-weight). The birth supply will become exhausted early owing to the rapid postnatal growth of the premature infant, the degree of haemolysis occurring after birth, and the immaturity of the erythropoietic tissues.

Calcium is necessary for growth of the skeletal system, and for maintenance of the serum calcium at the normal level (9 to 11 mg. per 100 ml.). When there is gross deficiency of calcium in the diet, or failure of utilisation due to lack of vitamin D, rickets and osteoporosis occur; the serum calcium level is usually maintained by mobilisation of calcium from the bones, but when this mechanism breaks down and the serum calcium falls below 6 mg. per cent, tetany develops. The daily calcium allowances have been estimated (B.M.A.) as 1·0 g. up to the age of ten years, and 1·3 g. at thirteen to fifteen years. Milk and cheese are rich sources of calcium, and if the equivalent of at least one pint (568 ml.) of milk a day is included in the diet there is no danger of primary calcium deficiency; tinned sardines are also rich in calcium.

Phosphorus is not only required for skeletal development, occurring in bone as inorganic phosphorus, but is also widely distributed in the tissue fluids and forms an essential constituent of phospholipids, phosphoproteins, and nucleoproteins. The level of inorganic serum phosphorus shows considerable variation with season and age, being highest in infants exposed to sunlight and receiving vitamin D, and falling during childhood and adolescence. There is considerable difficulty in estimating the optimum daily intake of phosphorus, since its absorption will be affected by the other constituents of the diet. Phosphorus deficiency will not occur in a mixed diet in which milk is liberally included.

Iodine requirements in infancy are normally provided by milk, and deficiency will only occur in breast-fed infants when the maternal diet is grossly deficient. In mountainous districts in which the iodine content of the water supply is abnormally low, thyroid enlargement is liable to occur amongst older children (see endemic goitre, p. 435. The deficiency of natural idone can be remedied by the routine use of iodised table-salt. The estimated daily allowance (B.M.A.) from two to fifteen years is 150 μg.

Trace elements are thought to be concerned with enzyme action, and though essential for metabolism are present in animal tissues in very minute quantities. With the possible exception of copper (Bush, 1956), deficiencies of these elements are not known to occur in human nutrition.

Fluorine. Although it is doubtful whether fluorine is an essential constituent of human diet, it has been shown conclusively that populations dependent on water supplies containing less than 1 part per million of fluorine have an abnormally high incidence of dental caries. (In areas where the fluorine content of water is excessively high, dental fluorosis results in mottling of the enamel of the teeth.) The raising of the fluorine content of low-fluorine water supplies to 1 part per million has been abundantly justified as a harmless public health measure which is effective in lowering the incidence of dental caries. The best results are likely to be achieved when women have consumed the treated water throughout pregnancy, and infants have subsequently been supplied with it before the eruption of the first dentition. In spite of the considerable sales resistance which attempts to introduce changes in water supply have met with, appropriate fluoridation of water is now becoming increasingly accepted as a desirable means of combating one of the commonest causes of dental ill-health in childhood (Report of U.K. Mission, 1953).

Vitamin Requirements

Despite the enormous literature relating to the vitamins there are still considerable gaps in our knowledge as to the optimum intake during infancy, childhood and pregnancy. Recommended daily allowances should be regarded as liberal estimates designed to cover minimum requirements, *i.e.* to prevent vitamin deficiency, plus a safe margin. There is, for instance, little evidence in the case of vitamin C as to whether it is desirable to maintain saturation of the blood, though for pregnant and lactating women it is assumed that a higher intake is necessary to allow for the excretion of the vitamin in the milk. In receiving the available evidence, the B.M.A. committee recommended the following daily allowances:

TABLE 6

Age	Vit. A and carotene I.U.	Vit. D I.U.	Thiamine mg.	Niacin mg.	Riboflavin mg.	Vit. C mg.
0– 1	3,000	(see below)	0·4	4	0·6	10
2– 6	3,000	400	0·6	6	0·9	15
7–10	3,000	400	0·8	8	1·2	20
11–14	3,000	400	1·1	11	1·6	30

The dosage of vitamin D originally recommended during the first year of life was 800 international units, but this is now regarded as being too high except for premature infants (see below). A total dosage of 400 i.u. vitamin D from all sources is probably optimal for full-term infants. When milk preparations or infant foods have been fortified by the addition of vitamins during manufacture, they should bear the vitamin content on the label (Pharmacy and Medicines Act, 1941), as should preparations classified as foods (Labelling of Food Order, 1944).

Vitamin A and carotene. Although the major manifestations of vitamin A deficiency (xerophthalmia in infants and night-blindness with keratosis in children) are now comparatively seldom seen in Great Britain, their occurrence during periods of economic depression (Spence, 1931) is a reminder that prophylaxis cannot be neglected. In parts of South-east Asia, infantile xerophthalmia is still an important cause of blindness. The recommended allowance of 3,000 international units of vitamin A and carotene given above is based on a mixed diet containing one-third vitamin A and two-thirds carotene, the individual allowance being 1,500, *i.e.* vitamin A or 4,500 i.u. carotene. Since vitamins A and D are usually given to infants in a single preparation, dosages of the various preparations in common use are considered under vitamin D. Prolonged and extreme overdosage of vitamin A has been found to produce bone changes and hepatosplenomegaly (Josephs, 1944), whilst excess of carotene results in carotenaemia and yellow-staining of the tissues. Under normal circumstances, however, there is evidently a very wide range of vitamin A intake which will protect against deficiency symptoms and which will not produce signs of overdosage.

Vitamin B complex. The human requirements of a number of the components of the vitamin B complex, *e.g.* folic acid, biotin, pyridoxin and pantothenic acid, are not accurately known, and even in the case of thiamine (aneurin, vitamin B_1), riboflavin, and nicotinic acid (niacin) the recommendations are to some extent empyrical. Thiamine and riboflavin are widely distributed in natural foods, occurring in milk, meat, fish, eggs, green vegetables and fruits. Niacin also occurs in meat and wholemeal bread, but to a lesser extent in milk and vegetables. Niacin deficiency is most likely to occur in populations where the staple diet is maize, and is otherwise very restricted. It is usually unnecessary to supplement a mixed diet in childhood with vitamin B complex, and thiamine deficiency in infants (infantile beri-beri) is only likely to occur in the breast-fed infants of mothers whose diet is almost entirely limited to milled rice. Where it is thought desirable to supplement the diet in childhood with vitamin B complex, this can be done by including marmite or a yeast preparation.

Vitamin C (ascorbic acid). Unlike the calf, the human infant cannot synthesise vitamin C, which must be supplied in the diet. Since human milk normally contains 4 to 7 mg. per 100 ml., the requirements of the breast-fed infant are supplied from this source unless the mother's diet is grossly deficient. Artificially fed infants require additional vitamin C in the form of six teaspoonfuls of fresh orange juice, tomato juice, or black currant puree, one to three teaspoonfuls of elixir of rose hips (B.P.C.), or ascorbic acid. (See also Welfare Foods, Chapter 11.) Since vitamin C is thermolabile and destroyed by alkalis, preparations should not be boiled or have alkalis added. The allowance of 10 mg. for infants and 15 mg. for children of two to six years is usually exceeded, *e.g.* 25 mg. for infants and 50 mg. for older children, there being no risk of overdosage.

Vitamin D. The synthesis of vitamin D from its precursor in the skin by the action of ultraviolet light provides a natural source which is only likely to be adequate when the infant or child is freely exposed in a sunny climate. It is often inadequate in a temperate or cold climate, particularly during the winter months and under urban conditions, where smoke-pall filters off much of the ultraviolet radiation from both sun- and sky-shine. Under these conditions the excretion of vitamin D in human milk is low, and it has been estimated that breast-fed infants are unlikely to receive more than 20 i.u. daily from this source (Kon and Mawson, 1950). It is therefore recommended that both breast-fed and artificially fed infants in temperature climates should receive a daily supplement of vitamin D by mouth, and whilst deficiency symptoms (rickets or osteomalacia) are unlikely to occur after the age of two on a liberal mixed diet, it is probably desirable for pre-school children to continue the supplement during the winter months. There is some evidence that the natural product occurring in fish-liver oils (D2) is more effective than the synthetic product, calciferol (D3), and that absorption is better when the supplement is given with milk. The recommended daily dosage of 400 i.u. for full-term infants should be at least doubled for premature infants, the requirements of the latter being not only greater but arising earlier in life (before the third month). Whilst these recommendations are often exceeded a moderate surplus is unlikely to produce signs of over-dosage in normal infants if the vitamin intake from all sources is taken into account.

Natural cod-liver oil contains from 8,000 to 30,000 i.u. vitamin D per 100 g. edible portion, and halibut-liver oil 20,000 to 100,000 i.u. Care must be taken to avoid overdosage if the latter is used in preference to less potent preparations. Cod-liver oil compound (British Welfare Foods 1958 Standard), issued through infant welfare centres, is a preparation containing 10,000 i.u. vitamin D and 60,000 i.u. vitamin A per 100 g., the daily requirements being included in one teaspoonful (5 ml.). The use of supplementary vitamin preparations, however, must be guided by the vitamin intake from other sources, *e.g.* fortified cow's milk preparations or fortified margarine, which latter contains 80 to 350 i.u. vitamin D per 100 g.

Vitamin K. Whilst vitamin K is an essential factor in the formation of prothrombin in the liver, it can be synthesised by the action of bacteria in the gut. Haemorrhage due to deficiency is only liable to occur in older subjects in the presence of biliary obstruction or malabsorption of fats, including the fat-soluble vitamin. In newborn infants, hypoprothrombinaemia may result in haemorrhagic disease of the newborn, and when due to vitamin K deficiency can be corrected by administration of the vitamin or a water-soluble analogue, *e.g.* Synkavit in a dosage of 1 or at most 2 mg. intramuscularly. Larger doses of analogue are liable to cause haemolysis and kernicterus (see Chapter 3).

Breast Feeding

This is still the ideal method of infant feeding, notwithstanding the great improvements in artificial feeding of the last fifty years. Breast feeding should therefore be encouraged unless there is some real contra-indication. The familiar arguments in its favour still hold good. Human breast-milk is the food most perfectly adapted to the infant's needs; it is provided at the optimum temperature, and the risk of contamination is minimal. It has the economic advantage of passing direct from producer to consumer. The incidence of infection and gastro-intestinal upsets is significantly less in breast-fed infants as compared with those artificially fed except under optimal hygienic conditions. The comfort enjoyed by the infant in contact with a soft breast instead of a hard bottle, and the confidence gained by the mother in supplying the infant's needs herself, are factors in the successful rearing of infants which it is difficult to assess statistically, but which may be assumed to have real importance. Unfortunately many women start with the conviction that they are unable to feed their infants, either because their own mother did not do so, or because a previous attempt was unsuccessful, or because lactation has been established late. It is therefore most desirable that advice and encouragement with regard to breast-feeding should be given during pregnancy, and that any social, economic or physical difficulties which can be overcome at this stage should be recognised early and not left until too late. This is particularly important during a first pregnancy, as successful breast feeding of a first infant usually means that subsequent infants will also be breast-fed.

Preparation of the breasts. This should begin during the latter months of pregnancy. The breasts should be bathed at least once a day, and dried with a rough towel. This will tend to improve the circulation, and render the nipples less tender and less liable to crack. The mother should be warned against clothing pressing tightly on the nipples and breasts. A properly fitting support should be worn, particularly by women with heavy breasts; there is otherwise a danger of the breasts becoming pendulous, resulting in interference with the circulation and lymphatic drainage of the dependent parts. If the nipples are found to be retracted into the surrounding breast-tissue, the surface of the latter should be pressed away from the nipple in each direction laterally, and the nipple drawn forward gently. Plastic shields (Fig. 16) should be worn during the latter months of pregnancy in the treatment of retracted nipples. The shields allow the nipple to pass through a central aperture in the base which is applied to the areola, whilst a curved anterior portion protects the nipple from the pressure of the clothing. When worn under a firm support, the shield serves to press the nipple through the opening and gradually to stretch its attachment to the deeper structures. It is important that the breasts should be examined well before the end of pregnancy, as it is usually impossible to correct retraction if it is attempted rapidly after delivery. Rough handling of the breasts, scrubbing the nipples, or the deplorable practice of 'breaking the nipple strings' either before or after delivery are wholly undesirable and are liable to lead to the formation of breast abscess. Hardening of the nipples with alcohol is likely to produce exactly the condition it is intended to prevent, namely cracking, since it results in loss of elasticity. Waller (1946), in a well-controlled experiment, obtained excellent results by instructing pregnant women in massage of the breasts and expression of secretion during the latter months of pregnancy; it was found that the subsequent free flow of milk was thus more readily established, with a significant diminution of breast-engorgement, and that 83 per cent of the instructed mothers successfully breast-fed their infants for six months as compared with 42 per cent of the control group. The practice of antenatal expression of breast-secretion has now become widely accepted, and in a number of clinics is established as a routine preparation for breast feeding.

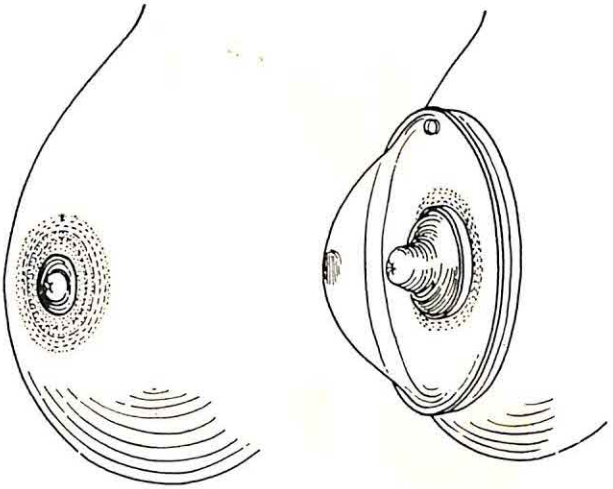

FIG. 16. Plastic shield applied over a retracted nipple.

Technique of feeding. Depending on the condition of the mother, the baby should be put to the breast two or three times during the twenty-four hours after delivery. He will only obtain small amounts of colostrum during this time, but the sucking reflex will be initiated and lactation stimulated. Mother and baby will have the opportunity of adapting to one another before suckling begins in earnest.

In establishing the subsequent régime, it is essential to bear in mind that the régime is intended primarily for the benefit of the baby, secondarily for the benefit of the mother, and only thirdly and lastly for the convenience of the nurse. Amongst primitive peoples, the baby is usually put to the breast when it cries, and, since hunger is the strongest emotion in the young infant, an irregular otherwise frequent changes of position will disturb the infant and will make nursing unnecessarily tiring. If possible, the mother should rest for a short while before each feed. An atmosphere of anxiety and hurry will inevitably react both on the infant and the milk supply, whilst any interference or disturbance by other people is likely to be resented both by the mother and the baby.

The infant should be held in the crook of the mother's elbow, with the head and shoulders raised (Fig. 17). It is not uncommon to see both breast- and bottle-fed infants placed horizontally, a position making it difficult for the infant to swallow and liable to result in regurgitation into the nasopharynx. There must be a clear air-way to allow the infant to breathe comfortably whilst sucking. If there is any nasal obstruction, the nose should be gently cleaned with a wisp of cotton wool before feeding, and care should be taken that a pendulous breast is supported with the mother's free hand to prevent it smothering the infant's face.

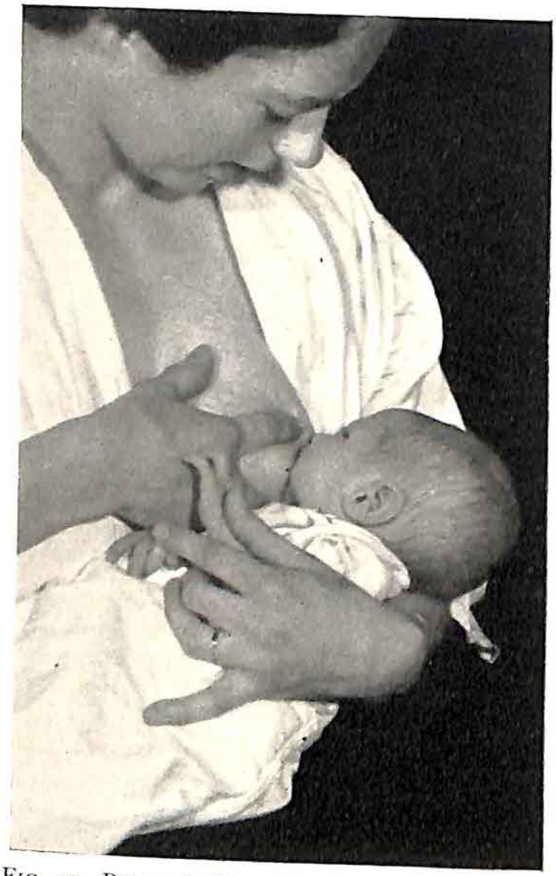

FIG. 17. Breast feeding. The infant is held with head raised, and the breast is supported by the mother's right hand to allow the infant a clear air-way.

Composition of breast milk. Different samples of human milk vary considerably in composition, depending on whether they represent the first or last part of the feed, and on the time of day at which they are taken. Nims *et al.* (1932), studying samples taken at four-hourly intervals from the same woman, found a steep rise in fat content at approximately 10 a.m. which could not be altogether accounted for by activity. The mother's diet, if ill-balanced, and her exposure to sunlight, may also affect the composition of the milk, particularly with regard to vitamin content. The milk drawn from the breast at the end of the feed has a higher fat-content than the 'fore-milk'. The testing of individual samples is therefore apt to be deceptive unless the breast is completely emptied at the time of a feed and a sample taken throughout the twenty-four hours. Average values for the percentage composition of human and cow's milk are shown in Table 7.

The protein consists of lactalbumen and caseinogen, which are present in the proportions of 0·75 and 0·50 per cent respectively. The fat-content is the most variable factor (other than total volume), and the carbohydrate-content the least. Human and cow's milk both have a caloric value of approximately 20 calories per fl. oz. (or 70 calories per 100 ml.). The infant's fluid and caloric requirements will therefore be supplied by 2½ fl. oz. per lb. body weight per day (156 ml. per kg.). In practice, it is found that many large active babies take considerably more than this amount.

Except in rare cases of allergy, it is very seldom that the quality of the mother's milk is really unsuitable for her infant, though babies are frequently weaned on this supposition. In cases of difficulty, the fault is much more likely to lie in the quantity of milk or the technique of feeding. Occasionally it is found that a woman who is on a grossly deficient diet herself is secreting milk which has a deficient vitamin content; here the remedy lies in the correction of the maternal diet. Iron-deficiency anaemia in the mother should also be treated, though normally the iron-content of the milk is not increased by increased maternal intake. Certain drugs, *e.g.* bromides, chloroform, belladonna, arsenic, iodides, cascara, opium, sulphonamides, salicylates and possibly mercury, when taken by the mother may be excreted in the milk in sufficient quantity to affect the infant, and the nursing mother is well advised to avoid alcohol except in minimal amounts, and smoking. Barbiturates are also excreted (Tyson *et al.*, 1938) and in large doses may affect the infant; the evidence with regard to the excretion of phenytoin is less conclusive, but it cannot be regarded as without risk (Finch and Lorber, 1954). Thiourea is excreted in sufficient concentration to be potentially toxic (Chesley, 1944) and mothers on anti-thyroid treatment should not breast-feed their infants. New drugs of which the excretion in milk has not been tested may represent a potential danger. If these possibilities are kept in mind, and local infection of the breast excluded, it can generally be assumed that the quality of the breast milk is not the cause of feeding difficulty.

Lactation is usually established in from three days to a week after parturition. Before this time the breasts contain colostrum, a secretion having considerable nutritive value and possibly some anti-infective properties also. It is yellow in colour, and has a relatively high protein content, containing less fat and carbohydrate than the later milk. It should be realised that the change from colostrum to milk secretion is not a sudden and complete process taking place on a particular day; it is often several days, or even three weeks, before lactation is fully established. Nevertheless, women whose lactation is adequate by the tenth day are very much more likely to breast-feed successfully for five or six months than those whose lactation is inadequate at this time (Miller, 1952).

The supply of breast-milk is partly dependent on the demand, and the most important stimulus to secretion is a strongly sucking infant who empties the breast at each feed. Stripping of the breast manually or by breast-pump at the end of the feeds will often increase the supply when the infant is sucking feebly or when additional breast-milk is required for another baby. As long as the mother's health is good, her milk supply is unlikely to be affected much by her build, but there is some evidence (Miller, 1952) that the duration of breast feeding in women under five feet in height compares unfavourably with that of the great majority who are over five feet. The same author also found that elderly women (whether primipara or multipara) were less successful in breast feeding than younger women of similar parity.

Although early weaning may often be avoided by suitable antenatal preparation (both physical and psychological) for breast feeding, coupled with postnatal care devoted to the breasts, the technique of feeding, and the mother's health, it must be admitted that there are many failures of lactation during the first two to six weeks after delivery. Some of these are attributable to breast-engorgement (see below), but in other cases, lactation fails prematurely for no apparent reason. Even allowing for the fact that anxiety and resumption of household duties will cause a temporary reduction in milk-supply when the mother returns home, there do appear to be other factors which make breast feeding less universally practicable amongst civilised and predominantly urban communities in temperate climates than amongst primitive peoples. The genetic factors involved in human lactation have perhaps received less attention than they deserve in view of the well-recognised importance of breeding on milk-yield in farm animals. In primitive communities where successful breast feeding is essential for the survival of the infant, it is understandable that, by natural selection, profuse lactation becomes virtually a racial characteristic. (This is illustrated by extreme examples where lactation occurs independently of pregnancy from the stimulus of a sucking infant. In one such case, personally observed, a Nigerian woman in her late fifties, whose last pregnancy occurred seventeen years earlier and who was four years past the menopause, had put her grandchild to the breast when the mother had died. When seen some weeks later, she was lactating freely and milk which appeared normal on naked-eye examination was readily expressed from both breasts.) In communities in which the majority of artificially fed infants will survive, on the other hand, there is not nearly the same likelihood of poor-lactating strains dying out, and in Great Britain and North America they may now form a substantial proportion of the population.

The mother's diet should be liberal and well balanced, containing fresh vegetables, butter, eggs, and the equivalent of one and a half pints of milk per day in fresh milk or dairy produce. The fluid intake should be higher than normal. Fresh air and a reasonable amount of exercise are most desirable, whilst worry and fatigue are likely to affect the milk supply adversely.

Breasts and nipples. The size of the breast is apt to be deceptive, a small firm breast often giving a larger milk yield than a larger pendulous one. The nipples should be kept scrupulously clean, being carefully dried and covered with gauze after each feed. The commonest disability is *breast-engorgement* during the puerperium, and this should be recognised and treated early. In minor degrees of engorgement, the breast feels heavy and uncomfortable, and may be appreciably harder than normal on palpation. Manual expression of milk and support of the breast will usually relieve the engorgement until the infant is able to empty the breast effectively. In more severe degrees, the breast becomes oedematous and the flow of milk obstructed. Here the breast must be rested, and the engorgement should be relieved by the administration of stilboestrol for two or three days. The infant should only be be returned to the breast when oedema has subsided and free milk-flow has returned. (Antenatal prophylaxis of engorgement has been considered above.) If there is any evidence of *mastitis*, with flushing of the breast, pain and temperature, penicillin should be given promptly.

Sore or cracked nipples cause great discomfort, and may be due to the infant's continued sucking on an oedematous breast where milk-flow is obstructed. In some women, however, the skin appears to be exceptionally fragile. The infant should not be allowed to suck directly on a sore nipple. It may be possible to continue nursing by the use of a metal or plastic nipple-shield, but often the infant will have to be taken off the breast, and fed on expressed breast milk, until the lesion has healed. Sore nipples should be treated with Friar's balsam and cracks or fissures with penicillin cream, since they are like to be infected. (The remarkable infrequency of sore or cracked nipples amongst primitive peoples is probably due partly to unobstructed lactation and also to the free exposure of the breast to the sun.) *Breast-abscess* is liable to arise from neglected mastitis or cracked nipples. The infant must be taken off the affected breast completely until the abscess has been treated and healed, though it may be possible to continue breast feeding subsequently.

Nipples that are too large or too small for the infant to suck comfortably will in some cases make breast feeding impossible, though in other cases perseverence and temporary manual expression of milk may result in the infant becoming able to cope with the difficulty. Sucking on any part of the breast other than the nipple is liable to cause a painful haematoma.

Test-weighing. When there is doubt as to whether the breast-milk supply is adequate, a series of test feeds can be carried out. The procedure is not recommended after the first week when a baby is doing well on the breast and no troubles are being encountered, except possibly to illustrate to an intelligent mother the normal differences in milk intake at different feeds, and the short time in which the greater part of the feed is obtained. The infant is weighed before and after feeding, the difference in weight representing the weight of the milk consumed; it is not necessary to undress the baby, as it is only the difference in weights that is significant, and a napkin wetted during the feed should not be changed until the baby has been re-weighed. Since the amount of breast-milk varies considerably at different times of day, usually being highest in the early morning, and lowest at the mid-day and afternoon feeds, it is advisable to average the amount taken during at least three feeds in order to obtain an indication of the daily intake. By this means it is possible to estimate the amount of complementary feeding required when the breast-milk is inadequate.

Difficulties in breast feeding. Apart from air-swallowing and abnormalities of the nipple, which have already been referred to, the principal difficulties that arise in breast feeding are (1) under-feeding, (2) inability of the infant to suck, (3) unwillingness of the infant to suck ('breast-shyness'), (4) disinclination or fear on the part of the mother, and (5) interference on the part of relations.

(1) *Underfeeding* is usually due to an inadequate supply of breast-milk, which can be demonstrated by test-feeding. The infant fails to gain weight, and at first goes ravenously to the breast and still appears hungry and restless at the end of a feed. There may be excessive air-swallowing. In prolonged under-feeding, the infant becomes apathetic, and appetite is diminished rather than increased. Test-weighing will show which feeds are inadequate and should be complemented.

It is unfortunately too often the case that breast feeding is never attempted or is abandoned completely within the first month owing to failure of lactation. Even in the days when over 80 per cent of babies were being breast-fed when they left hospital or when the midwife ceased to attend about the tenth day, the percentage was found to drop to 50 by the end of three months. Robinson (1943), in an analysis of 1,100 cases of premature weaning, found that 50 per cent occurred within the first month, and that in 40 per cent of these early failures there appeared to be no adequate cause. Waller (1946) regarded defective functional capacity of the breast as the major cause of premature weaning, and as already indicated has made out a strong case for the manual expression of fluid and colostrum from the breast during the last months of pregnancy, with the purpose of establishing a free flow of milk when lactation is established, and avoidance of engorgement of the breast and subsequent 'drying-up' of the milk supply.

It is undoubtedly true that mothers whose milk flows spontaneously from the nipple as the breasts become filled very seldom have any difficulty in successfully breast feeding their infants. Sore nipples and breast-abscess also occur seldom when there is a free flow of milk and absence of congestion.

(2) *Inability of the infant to suck* may be due to general feebleness, prematurity, mental defect, or to lesions of the lips and mouth. In the case of an infant who has previously sucked well the mouth should be carefully examined for local lesions, of which thrush is the most common. The 'sucking blisters' often seen on the lips of young breast-fed infants do not usually cause any disability. It is extremely rare for shortness of the fraenum ('tongue-tie') to be responsible for difficulty in sucking, and the practice of cutting or tearing the fraenum in young infants is wholly unnecessary. It should be remembered that the tip of the tongue grows forward as the infant develops and what may appear to be 'tongue-tie' is usually a perfectly normal state in early infancy.

(3) *Breast-shyness.* The infant who is both hungry and able to suck but refuses the breast provides a problem requiring both patience and ingenuity for its solution. Painful local lesions of the mouth must of course be excluded. It will then sometimes be found that the infant has a blocked air-way or that the nipple is too large or too small for his mouth. In other cases the trouble is due to difficulty in initiating the flow of milk, and here moistening of the nipple with milk may encourage vigorous sucking. The possibility of the draught being too forceful and copious is referred to above. Temporary sedation with chloral will sometimes prove effective in overcoming breast-shyness for which no cause can be found.

(4) *Disinclination of the mother to breast feed* may be due to actual repugnance to the idea of breast feeding as such, to dislike of an unwanted baby, or to the feeling that breast feeding will intefere with her normal duties, employment, or

amusements. Such cases will sometimes respond to discussion and advice, particularly during pregnancy, but it must be admitted that an increasing number of young mothers are unwilling to breast-feed under any circumstances. Farquhar *et al.* (1965) found that the proportion of infants wholly or partially bottle-fed on discharge from a maternity hospital had risen from 28 to 43 per cent in the past five years. The mother who is determined not to be too closely tied to the baby throughout the whole day may agree to continuing two or more breast feeds if artificial feeds are substituted during the times she is most anxious to be free, but unfortunately few mothers persist with the double régime for very long. Fear and over-anxiety about breast feeding can be relieved by tactful supervision, and it is most important that the mother should gain confidence in handling and feeding her baby during the lying-in period.

(5) *Interference by relatives*, who are often well-meaning but misguided, is a frequent cause of failure of breast feeding. Some grandmothers are actively jealous of their daughter's breast feeding and so possessing the baby, and though the motivation may not come into consciousness they are only too eager to get the baby off the breast and take over the management of the bottle feeding. It is also sometimes found that the father dislikes the intimacy of the mother–child breast-feeding relationship and is glad to see it broken.

Constipation and diarrhoea. In view of the normal variation in the number of stools that different infants pass each day, the stools should be examined before a diagnosis of either constipation or diarrhoea is accepted. If the stool is of normal consistency for age and is passed without difficulty, the fact that stools are infrequent is no indication for medication. Similarly, stools may be small and frequent, but if not abnormally fluid or discoloured there is no cause for alarm. The passage of small 'hunger-stools' which are dark in colour is an indication of underfeeding rather than diarrhoea.

When the stool is harder than normal and causes discomfort on defaecation or shows streaks of blood on the outside, the anus should be carefully examined for the presence of a local lesion, and if necessary a rectal examination performed. Simple constipation can usually be overcome by increasing the fluid intake or adding orange juice to the diet; a simple natural laxative is one to two teaspoonfuls of stewed prune-juice. In more obstinate cases, milk of magnesia or senna is usually effective; stronger laxatives are inadvisable if they can be avoided. The aim in both infants and older children is to establish a natural and regular bowel action, and not to rely on purgatives. Parents are apt to forget that voluntary control of defaecation should be vested in the child and not in the medicine cupboard.

Diarrhoea in the breast-fed infant is usually due to parenteral infection or chilling, or occasionally to over-feeding in very hot weather, which may occur if no fluid other than milk is offered to relieve thirst. It provides in itself no indication for weaning, though it will be necessary to give additional fluids until the primary cause has been corrected.

Contra-indications to breast feeding are very few. Maternal diseases such as advanced cardiac disease, cancer, insanity, or pulmonary tuberculosis may form absolute contra-indications, though in the case of active pulmonary tuberculosis it should be remembered that the mother is almost as likely to infect the infant if she bottle feeds it herself as if she breast feeds it; in this case, segregation of the infant from birth until the mother's condition is inactive coupled with B.C.G. inoculation, is the logical procedure. Maternal diabetes is not an absolute contra-indication, since it has been shown that diabetic mothers whose condition is carefully controlled with insulin can sometimes successfully breast feed their infants without ill-effect. Syphilis acquired by the mother after delivery should be regarded as an absolute contra-indication, but if the infection precedes delivery, the infant will not suffer further harm from nursing from the mother. The excretion of drugs in the milk, *e.g.* when the mother is epileptic or is on anti-thyroid treatment is considered above.

Where the milk supply remains inadequate despite careful supervision, and the infant is failing to thrive on complementary or supplementary feeds, breast feeding may have to be abandoned altogether. No hard and fast rule can be given as to how long to persist in attempts to establish satisfactory lactation, but a point comes at which the baby is being sacrificed to the breast, and when the experienced advocate of breast feeding will know it is in the best interests of the baby to admit defeat.

Complementary and supplementary feeds. A *complementary* feed is an artificial feed given immediately after a breast feed when the breast-milk supply is inadequate for the infant's requirement. A *supplementary* feed is an artificial feed completely replacing one of the breast feeds. Complementary feeding should be looked on as a temporary measure designed to tide over a period of deficient lactation, *e.g.* when lactation is established late or when the mother is temporarily over-tired or debilitated. By complementing the feeds, it is possible to maintain the milk supply by giving regular stimulation to the breasts, and also to supply the infant's needs; the complement is reduced as the breast milk increases in amount. It is essential to give the artificial feed after the infant has been put to the breast and not before, as otherwise he will not suck vigorously on the breast or will refuse it altogether.

Supplementary feeds are given when the mother's health or occupation necessitate the omission of one or more breast feeds. Thus a working mother may be able to breast feed at night and in the morning but not at mid-day, whilst one who wishes to be free in the evening may be willing to nurse during the rest of the day.

Vitamin supplements. Although breast-fed infants are considerably less likely to suffer from vitamin deficiencies than are artificially-fed infants, orange juice and a vitamin D preparation (p. 113) should be given from the third month to full-term infants and earlier in the case of prematures.

Weaning. Weaning is much facilitated if small amounts of different foods, such as cereal, bone and vegetable broth, egg yolk, cod-liver oil and orange juice, have already been introduced at an early age (three to four months). Crusts or rusks should be given for the infant to chew at five months, though little will be actually eaten until the teeth have erupted. The length of time that breast feeding should be continued will depend to some extent on the condition of the mother, but from the point of view of the baby it is usually found in practice that it is considerably easier to start weaning at six months, when the baby is showing new interests in putting outside objects into his mouth, than if it is left to nine or ten months. From the nutritional point of view, it should be remembered that whilst there is no harm in the baby having drinks of breast-milk throughout the second year (as is a common practice in many communities where no clean milk supply is available), milk is inadequate as the sole source of iron after three to four months, and there is a real danger of nutritional anaemia occurring if breast-feeding is continued too long without supplementation with iron-containing foods.

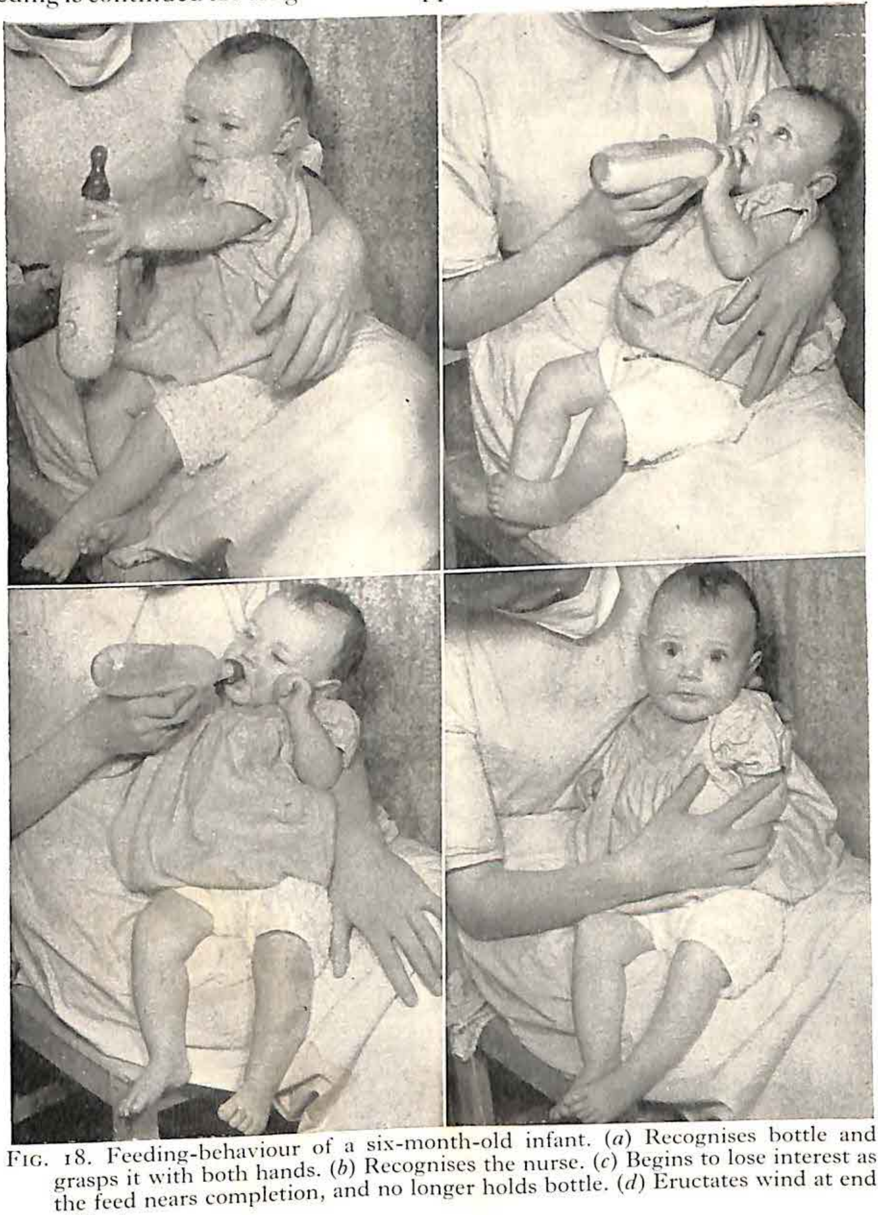

FIG. 18. Feeding-behaviour of a six-month-old infant. (*a*) Recognises bottle and grasps it with both hands. (*b*) Recognises the nurse. (*c*) Begins to lose interest as the feed nears completion, and no longer holds bottle. (*d*) Eructates wind at end of feed.

Weaning should not be begun if the baby is ill or during very hot weather, but for the normal infant a practical policy is to omit one breast feed each week during the seventh month, until the baby is off the breast early in the eighth month. At this age the baby can digest whole cow's milk (either boiled or pasteurised liquid milk, or full-strength dried milk) and soft solids (cereal, egg, potato, sieved green vegetables, apple sauce, and small amounts of mince). The reaction to a new taste is often a negative one, and the baby should be offered new foods, with a chance of indulging preferences rather than being forced to eat them.

Some valuable studies on self-selected diets during the toddler period have been carried out by Davis (1928) and others, in which infants of the weaning age were allowed to eat what they chose out of a reasonably large selection of foods. It was found that they not only throve on this régime, but that diets they selected were adequate in quantity and practically optimal in composition.

Expressed and stored breast-milk. Expressed breast-milk is sometimes used for the feeding of small premature infants, and when the mother is herself unable to maintain the supply, pooled breast-milk may be used from mothers who have more than enough for the immediate needs of their own infant. In some centres it has been felt desirable to set up 'breast-milk banks' or bureaux. Milk is purchased from mothers able to supply it (sometimes months after weaning their own infant), and after pasteurisation the milk can be frozen, stored, and sold for the use of premature or other infants requiring it. Particulars of organisation of banks and methods of preservation of breast-milk are given by Mackintosh (1947), Wright (1947) and the American Academy of Pediatrics (1943). When milk is purchased and its expression is not carried out at the centre or under direct supervision, it may be necessary to test for dilution with water or cow's milk; the various tests for adulteration are discussed by Miller and Ellis (1953). With improved methods of artificial feeding, however, the use of pooled breast-milk is tending to decrease.

The special problems of feeding small premature infants are considered in Chapter 3.

Artificial Feeding of Infants

Practically all the standard methods of artificial feeding of infants are based on the use of cow's milk, and since the digestive system of the young infant is perfectly adapted to the digestion of human milk but not to that of cow's milk, some modification of the latter is advisable. If the composition of human and cow's milk is compared, it is seen that not only does human milk have a higher carbohydrate content, but that the total and relative proportions of the milk-proteins are different:

TABLE 7

	Human milk	Cow's milk
Caloric value (per fl. oz.)	20	18–20
(per 100 ml.)	70	70
Carbohydrate (lactose) per cent	7	4·75
Fat	3·5–4	3·5–4
Total protein	1·25	3·4
Lactalbumin	0·75	0·4
Caseinogen	0·5	3·0
Total minerals	0·2	0·73

Unmodified cow's milk forms a larger and tougher curd than human milk, and the buffering action is three times as great. In fact, the percentage of fat and the caloric value are the only two factors which correspond closely on average analysis, and both of these are variable in individual samples.

The curd of cow's milk can be modified and rendered more digestible in a great variety of ways, *e.g.* dilution, boiling, evaporation, drying, or by the addition of sodium citrate or lactic acid, and all these processes have been employed in infant feeding. It is not intended to give more than an indication of the methods that are found satisfactory, or of the types of proprietary foods that are normally available, since a great many unnecessary complications have been introduced in a misguided attempt to make infant feeding an exact science. These for the most part have defeated their own object, since the infant is not a test-tube nor the working-class kitchen a laboratory.

Dried and Condensed (Evaporated) Milks

The use of either dried or condensed milk has to a large extent replaced the use of liquid milk in infant feeding, since 'processed' milk from which a proportion of the water has been removed by heat, has certain practical advantages as regards sterility, storage and preparation. The cow's milk curd is rendered less tough and more readily digestible by the drying process, and in practice this has led to more concentrated feeds being given, so lessening the risks of underfeeding.

Dried milk powder is prepared commercially either by roller drying or by spray drying. In the former process, liquid milk (either whole, skimmed or partially-skimmed) is run over heated rollers, and the powder formed is scraped off. In spray drying, a fine jet of liquid milk is forced under high pressure into an enclosed tower where the droplets of milk meet a moving current of hot air, the dried particles falling to the bottom. In both processes, burnt particles are removed before packing. Both dried and condensed milks used for infant feeding are fortified with vitamin D before heating.

Condensed milk is prepared by reducing the water-content of liquid milk by boiling in a vacuum of 28 to 29 in. mercury, the milk at this pressure boiling at a temperature of between 102° and 130°F. Unsweetened condensed milk is run out when sufficiently concentrated, cooled, homogenised and subsequently sealed in tins and sterilised. (In the case of sweetened condensed milk, which is not suitable for routine infant feeding, sugar is added to the heated whole milk before condensation, and the final product, which has a sucrose content of approximately 44 per cent, is not sterilised). The average percentage composition of whole and skimmed dried milk, and of unsweetened and sweetened condensed milk, is shown in Table 8.

TABLE 8

Percentage Composition of Types of Dried and Condensed Milks

	Dried milk		Condensed milk	
	Whole	Skimmed	Unsweetened	Sweetened
Fat	27·5	2·0	9·1	9·1
Protein	24·5	36·0	8·6	8·4
Lactose	38·0	49·5	12·5	12·1
Sucrose	—	—	—	43·5
Ash or mineral matter	6·0	8·0	1·8	1·8
Water	4·0	4·5	68·0	25·1

Types of dried milk. A great many proprietary brands are on the market, and the manufacturer's literature must be consulted for the individual composition. The majority of these are manufactured so that 1 drachm by weight of powder made up to 1 fl. oz. with water will form 1 fl. oz. of reconstituted milk or 'modified milk mixture' having the caloric value of whole milk. Since the specific gravity of the various brands varies, a scoop which contains 1 drachm by weight is usually provided by the manufacturers. (If the metric system is used, the proportions are 100 g. of powder made up to 800 ml. with water, or *pro rata* amounts.)

The popularity of proprietary dried milks is due to their being designed so that, when reconstituted as directed, they provide a feed for infants of different ages, with little or no further modification. National Dried Milk, however, is considerably cheaper, and equally satisfactory for infant feeding if properly used. The following are the more important types of dried milks available:

'Humanised' dried milks. In these the percentage composition of the dried milk is so modified that when the milk is reconstituted by addition of the appropriate amount of water, it has the approximate composition of breast-milk. Thus the percentage of carbohydrate is raised and an adjustment effected in the relative proportions of caseinogen and lactalbumin. These milks are suitable for the feeding of young infants without further modification, but are unnecessarily expensive for routine use.

'Modified' dried milks. A large number of modified dried milks are normally available, of which the essential feature is that the fat-content of the reconstituted milk is reduced to 2 per cent and carbohydrate-content raised to give a caloric value of 20 calories per fl. oz. of reconstituted milk; the total protein-content may be reduced to 2 or 2·5 per cent. These milks are suitable for the feeding of infants up to three months of age, usually without further modification. They are sometimes described as 'modified half-cream' milks, owing to the reduction of fat-content. They are reinforced with vitamin concentrates.

Dried partly skimmed milk ($\frac{3}{4}$ or $\frac{1}{2}$ or $\frac{1}{4}$ cream) is unmodified except for the drying and removal of a proportion of the cream. The tin must be labelled 'Should not be used for babies except under medical advice'. These dried milks have considerable value in infant feeding, since although the caloric value of the reconstituted milk is reduced below per 20 fl. oz., it may be desirable in particular cases, *e.g.* following diarrhoea, to give an infant milk in which both the fat- and carbohydrate-content is low; carbohydrate can then be added gradually as desired. 'National Dried partly skimmed milk' is suitable for feeding younger infants with appropriate modification (see below).

In the case of 'Dried Machine-skimmed Milk' (or 'Dried Skimmed Milk'), the tin must be labelled 'Unfit for babies', since the caloric value of the reconstituted milk is too low for routine use in infant feeding. Again, such milk may be valuable for a short period whilst the infant is recovering from a digestive upset, or in conditions where there is failure in absorption of fat.

Dried full-cream milk when reconstituted represents whole cow's milk, and since the toughness of the curd is modified by the drying process is suitable without further modification for feeding normal infants over four months of age. Most brands are fortified by the addition of vitamin supplements. National Dried Milk ('Modified dried full-cream milk') which is obtained through infant welfare centres, had proved a most successful basis for infant feeding, and is considered below.

Types of condensed milk. As in the case of dried milk, there are a number of proprietary brands of condensed milk available which have been modified for infant feeding so that only the addition of the appropriate amount of water is necessary.

Condensed full-cream milk, unsweetened, is cow's milk which has been heated to reduce the volume to one-half or one-third of that of the original milk. When reconstituted by the addition of the appropriate amount of water it can be used in the same way as whole cow's milk, and has similar advantages in modifying the toughness of the curd as dried full-cream milk.

Condensed machine-skimmed milk, unsweetened, is similarly processed after removal of the fat, and must be sold as 'Unfit for babies'. The same observations apply to its use as to dried skimmed milk.

Condensed full-cream milk, sweetened, is unsuitable for the routine feeding of normal infants owing to its high carbohydrate-content. It may sometimes be indicated in the feeding of small and feeble infants when it is desired to give a high caloric intake over a short period; but its extreme sweetness will often make a change to other feeding more difficult. If used over a long period it is likely to result in a fat, flabby infant with a low resistance to infection.

In addition to the above types of dried and condensed milks, there are a number of proprietary brands designed specifically for premature, anaemic, or sick infants. Lactic acid milk, either dried or freshly prepared from liquid milk, has in the past had considerable popularity in the feeding of both normal and sick infants, on the assumption that it could be used in a more concentrated form than unmodified milk. When prepared from liquid milk, 60 minims of lactic acid are added a drop at a time with continual stirring to one Imperial pint of milk in the cold. (This proportion corresponds to 45 minims to one American pint). Whey is still sometimes used temporarily in the feeding of sick infants, but is unnecessary in normal infant feeding. It contains minimal quantities of fat and less than 1 per cent of protein.

Feeding with National Dried Milk. This is now one of the most popular forms of artificial feeding in this country, and has the advantage of cheapness. The milk powder is of standard composition and can readily be stored and kept free from contamination. It has the slight disadvantages that the fat tends to separate after mixing, and the taste may make it an unwelcome change after other methods of feeding, though this does not apply if it has been used from birth.

The infant's daily fluid requirements are calculated as 2½ fl. oz. per lb. body weight, and divided by the number of feeds, *e.g.* a 6 lb. baby having six feeds requiring 2½ fl. oz. at each feed, a 7 lb. baby having five feeds requiring 3½ fl. oz., and a 12 lb. baby on five feeds requiring 6 fl. oz. This fluid volume is supplied as boiled water.

During the first week of life, ½ drachm of half-cream N.D.M. for each fl. oz. of water is measured and mixed to a smooth paste with boiled water. One level teaspoonful of sugar and the remainder of the water are then added. The infant should not be expected to take a full 2½ fl. oz. per lb. body weight during the first week, and for the first twenty-four hours boiled water only should be given. After the first week, the proportion of milk powder to water is gradually increased until when the infant is one month old, 1 drachm, *i.e.* one level scoop of powder is used for each fl. oz. of water and one and a half teaspoonfuls of sugar added to each feed. By the age of six weeks to two months, a change to full-cream N.D.M. can be made.

Using full-cream milk, the bulk of the feed is again calculated on the daily fluid requirements. Until the age of four months the number of scoops of milk powder used should be half a scoop less than the number of fl. oz. of water, with one and a half to two teaspoonfuls of sugar added. After the age of four months, most babies can tolerate 'full strength' reconstituted milk, *i.e.* one scoop to 1 fl. oz. The amount of added sugar is gradually reduced as soft solids are introduced into the diet, and at six months of age the infant should be taking full-strength reconstituted milk without modification.

The above recommendations are reasonably liberal but may require some modification in individual cases. It is always necessary to be guided by the infant's appetite, weight gain, and general well-being. If there is a tendency to loose stools, the added carbohydrate should be reduced, and a more dilute feed may be advisable in very hot weather. National dried milk contains not less than 100 i.u. vitamin D per oz. of powder, *i.e.* per 8 fl. oz. of full-strength reconstituted milk.

Feeding with liquid milk. Although the standards of milk production have greatly improved in recent years, it is essential to ensure that liquid milk used for infant feeding is fresh, sterile and clean, and it must be remembered that milk of whichever designation (tuberculin-tested, pasteurised or sterilised) may be secondarily contaminated before reaching the baby. In addition to the standard precautions necessary for sterilising teats, feeding-bottles, and utensils the milk itself must be stored in a cool place and protected from flies, and the feed brought to the boil and cooled to blood temperature before being given to the infant.

Despite the fact that many infants have been reared from birth on unmodified cow's milk, it is generally advisable to dilute milk and add carbohydrate at least in the case of younger infants. Except during the first week of life, when caloric requirements are low and there is little serious risk of under-feeding, care must be taken that this dilution does not starve the infant in respect of either protein or total calories.

On the first day of life, the infant should be given small amounts of boiled water only. During the next six days, 2 to 3 fl. oz. of equal parts of milk and water with one level teaspoonful of added sugar should be offered at approximately three-hourly intervals, the amount taken depending on the infant's appetite and capacity. At the end of the first week, the dilution is changed to two parts of milk to one part of water, with one teaspoonful of sugar added to each feed. (A mixture providing 20 calories to the fl. oz. consists of milk 12 fl. oz., water 6 fl. oz., and sugar 1 oz. by weight; this total amount would supply the needs of a baby weighing just over 7 lb.) The total volume of the day's feeds should now be approaching the infant's fluid requirements of $2\frac{1}{2}$ fl. oz. per lb. body weight, and the time between feeds can often be extended to three and a half hours without causing distress.

From the fifth week, a dilution of three parts milk to one part water, with added sugar, is usually well tolerated, and can be continued until the fourth or fifth month, when a gradual transition to undiluted and unsweetened milk is effected. The total amounts taken at each feed will necessarily depend on the infant's weight and appetite, and the length of time he can sleep between feeds. After the first month, the great majority of healthy babies will adapt readily to six feeds in the twenty-four hours, and subsequently to five feeds, provided that these are adequate and supply the fluid requirements. The amount of sugar added to the feeds should not exceed the proportion of 1½ oz. sugar to 20 fl. oz. whole milk. The more detailed calculation of feeds is discussed below (calorie feeding) In hot weather and during pyrexial illness, the dilutions of the feeds should be increased or additional fluid given between feeds.

Calorie feeding. Whilst an exact calculation of caloric intake is seldom necessary in the case of a baby who is thriving, it is often desirable to see whether requirements are being adequately covered when a baby fails to gain weight, or is being returned to a full diet after a period of illness. In such cases the allowance of 50 calories per lb. body weight per day, which is the average number required by a healthy baby to gain weight normally, may be insufficient for an underweight infant to catch up on his expected weight. It may then be necessary to calculate feeds on expected weight rather than on actual weight.

It is easiest to base calculations in the first instance on liquid milk having a fat-content of 4 per cent and a caloric value of 20 calories to the fl. oz.[*] (70 calories per 100 g.). Sugar, which may be added to the feed, has a caloric value of 120 per oz. or 4 calories per g. Under normal circumstances, the proportion of calories derived from added carbohydrate should not exceed one-fifth to one-third of the total. Taking the example of a baby weighing 10 lb., he will require a total of 500 calories in the day. His protein requirements will be covered by 1¾ fl. oz. cow's milk per lb. per day, and his fluid requirements by 2½ fl. oz. per lb. per day. This will give the following requirements:

Total calories = 500
Milk (10 × 1¾ oz.) = 17½ fl. oz. = 350 calories

The total fluid requirements (10 × 2½ fl. oz.), *i.e.* 25 fl. oz., will be made up by the addition of 7½ fl. oz. water. The additional calories required, viz. 500 − 350 = 150 can be made up by adding carbohydrate which having a caloric value of 120 per oz. will represent 1¼ oz. of sugar, *i.e.* 1 drachm per lb.

The complete requirements for the day will then be:

Milk	17½ fl. oz.	= 350 calories
Water	7½ fl. oz.	—
Sugar	1¼ oz. by weight	= 150 calories
	25 fl. oz.	= 500 calories

---

[*] The variation in the composition, and particularly the fat-content, of cow's milk introduces considerable errors into any routine system of caloric feeding. Thus Jersey milk, with a fat-content of over 5 per cent will have a higher caloric value than the figures quoted, whilst the values for milks lower in fat are as follows:

3·5 per cent fat	18 calories	per fl. oz.,	or	62	per	100 g.
3·0 per cent fat	16 ,,	,,	,,	57	,,	,,
2·5 per cent fat	15 ,,	,,	,,	53	,,	,,
Skimmed milk	10 ,,	,,	,,	34	,,	,,

Since the infant will be having five feeds in the day, the total daily requirements are divided by five to give the composition of each feed, viz.:

Milk	3½ fl. oz.
Water	1½ fl. oz.
Sugar	2 drachms.

When dried or evaporated milk is used which has not been modified by the addition of carbohydrate or skimming, the calculation is carried out in the same way except that the necessary amount of additional water is required to convert the dried or evaporated milk into reconstituted whole milk, *e.g.*:

Dried milk	17½ drachms.
Water	25 fl. oz.
Sugar	1¼ oz.

In the case of proprietary infant foods, it is necessary to calculate the infant's total daily caloric requirements, ascertain the caloric value of the reconstituted milk, and to make sure that the feeds are sufficiently large to cover the requirements.

Whilst 'calorie feeding' is a useful guide, it is essential that theoretical values should not over-ride clinical judgment. Its chief value lies in guarding against underfeeding, covering protein requirements, and avoiding the excessive use of carbohydrate. It must always be remembered that what will satisfy one healthy baby may prove insufficient for another, and that the caloric requirements on which the system is based are at best approximate averages.

General Principles of Artificial Feeding of Infants

To summarise the general principles of artificial feeding of infants:

(1) A feed with a high fat-content is not always well tolerated in early infancy, and it may be advisable to use a half-cream (or diluted) feed for the first three months.

(2) The curd of cow's milk, being tougher and less readily digestible than that of human milk usually requires modification (by dilution, evaporation or drying) for infants during the first four to five months.

(3) Added carbohydrate should not represent more than approximately one-fifth to one-third of the total calories of the feed. Since one Imperial pint of liquid (or reconstituted) whole milk has an approximate caloric value of 400, not more than 1½ oz. of sugar (calorie value 120 per oz.) should be added to the pint.

(4) If the feed is adjusted to an approximate caloric value of 20 calories to the fl. oz. (70 calories per 100 ml.), it will satisfy the infant's caloric requirements in a volume which corresponds with the normal fluid requirements.

(5) The feed should be warmed to approximately body temperature.

(6) The same general principles of establishment of régime by study of the individual baby rather than by a rule-of-thumb three- or four-hourly schedule apply as in the case of breast feeding, as do those of position and eructation of swallowed air. A baby should never be fed lying flat on its back, or left to feed itself with the bottle attached to the pillow, as milk is liable to enter the Eustachian tubes and result in otitis media.

(7) The teat of the bottle should be suitable for the baby's mouth, *i.e.* of a size and consistency such that the baby can take it well back into the mouth, and suck vigorously on it.

(8) The hole in the teat should be large enough for the milk to flow out drop by drop when the bottle is inverted. (This can usually be adjusted by passing a red-hot darning needle through the hole if it is too small.)

(9) It should be remembered that the risk of infection is greater in artificially fed infants than in those who are breast-fed, and bottles and teats should therefore be carefully washed and scalded after each feed, and kept scrupulously clean. Two types of bottle are in general use. The Soxhlet bottle is flat-bottomed, and can be stood upright in the rack, which is convenient when the day's feeds are sterilised together as is usually done in institutions. As air has to pass into the bottle through the teat to prevent the formation of a vacuum, the teat should be removed from time to time from the baby's mouth during the feed. The boat-shaped bottle has a valve fitted at the opposite end from the teat, so that air can enter during sucking, and has the advantage that when the valve is removed it can more easily be washed.

(10) During the seventh month the infant should begin to learn to drink milk from a cup or spoon. The same general principles of weaning and introduction of solid foods apply as in breast feeding, and it is equally important that iron-containing foods should form a substantial part of the diet during the second six months.

(11) Vitamin supplements are essential in artificial feeding, and the amount of vitamin D added to any proprietary preparation used should be known. Vitamin requirements and preparations are considered on p. 111.

Diet for Older Children

Menus calculated on dietetic requirements and food values are neither necessary nor desirable for older children, except when large numbers have to be catered for in institutions. The appetite factor is all-important, and if the older child has developed healthy feeding habits he will amply cover his requirements from the average middle- and upper working-class house diet. In the case of children from poorer homes, the factor most likely to be deficient is protein, since first-class protein (contained in meat and cheese) is one of the more expensive items. Here the diet tends to contain too high a proportion of starch and carbohydrate. The general provision of milk and school meals should go a long way to remedy the defect, though here again the previous failure to establish good feeding habits and appetite may defeat the intention. Le Gros Clarke (1942, 1943) carried out investigations on the schoolchild's reaction to school meals and tastes in vegetables, and found that when no persuasion was exerted, greens were refused by over 50 per cent of girls aged five to ten, and by 44 per cent of girls aged ten to thirteen; the percentage of boys in the same age groups was significantly lower. In underdeveloped countries, local food habits and cultural or religious taboos on available foods may prove an important contributory factor in malnutrition (Burgess and Dean, 1962).

Milk is particularly valuable during childhood and adolescence, since it not only provides first-class protein but is also one of the richest sources of calcium. A certain amount of discrimination must be used, however, in the time of day that drinks of liquid milk are given. Many children do not tolerate fat in large amount, and if milk is taken shortly before the main meal it may reduce appetite.

It is generally recommended that children up to five years of age should consume a pint of milk a day (including that used in cooking), and after this age at least three-quarters to one-half pint daily throughout the growth period if other first-class protein and calcium-containing foods are included in the diet. When younger children are unwilling to take this amount, the consumption of animal protein can be made up with cheese, lean bacon, or mince, according to preference. (Severe protein malnutrition occurring in recently-weaned children in the tropics is considered in Chapter 21.)

For infants during the weaning period, vegetables should be sieved. Subsequently a reasonable amount of roughage in the diet is useful in maintaining regular bowel action, since too small a stool will tend to result in constipation. Sufficient roughage is assured by the regular inclusion of green vegetables and fruit in the diet.

It is still only too common to find a weekly purge included in the working-class diet. That is wholly unnecessary, and tends to produce exactly the condition it is intended to avoid. If the child is costive increased fluid intake, regular exercise, and fruit will usually achieve the desired result. It is most important that the child should have the time for a regular bowel action, as constipation is often found to be due to the only lavatory being required by several children simultaneously before they leave for school.

As a general rule, the diet of older children will inevitably fall into line with the diet of the adults with whom they live, varying from country to country and household to household. But one of the more useful contributions which either the mother or school can make is the avoidance of monotony; choice and variety are almost as important as palatable cooking, and the child has to explore the gastronomic world as he does the social and spiritual.

R. W. B. ELLIS

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Chapter 6

POSTNATAL GROWTH

Growth and development. Although growth and development are closely related, and both continue from the moment of conception to the point at which adulthood is reached, they are essentially two different processes. *Growth* implies increase in size, typically coupled with cell-division and enlargement of protoplasmic and skeletal structure, whereas *development* represents increasing matura-

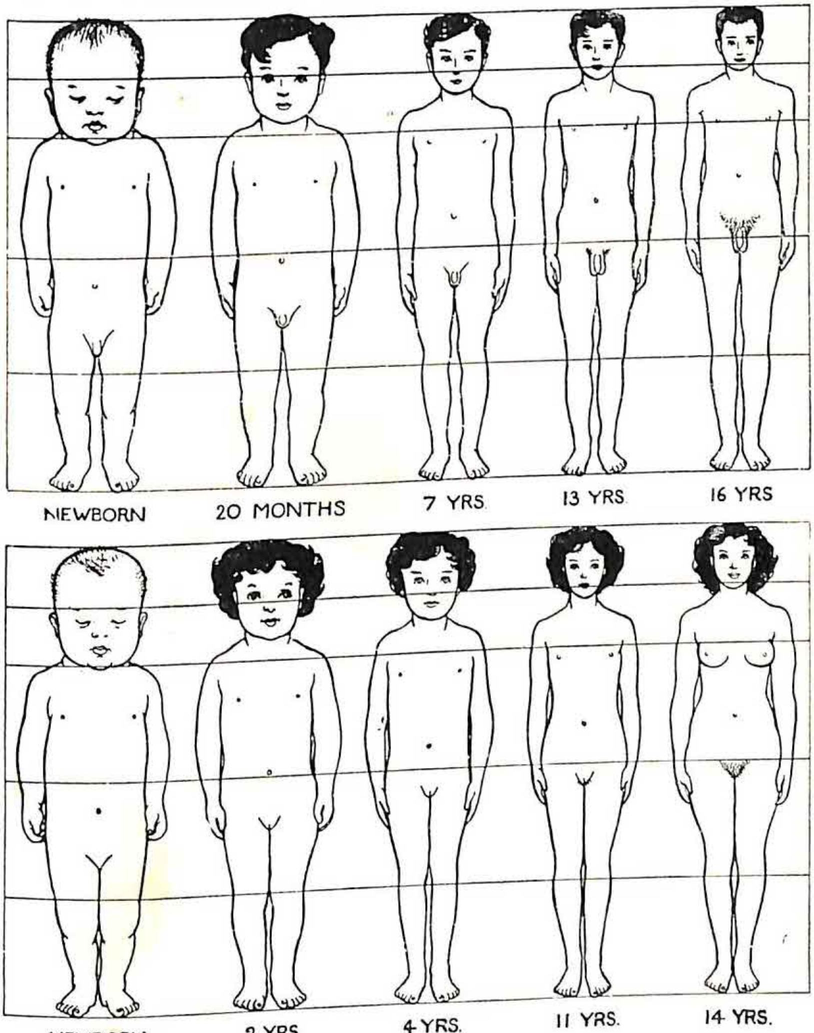

FIG. 19. Diagram showing relative proportions of the body from birth to adolescence.

tion of tissues, organs, or of the whole individual until full maturity of structure and function is attained. As a general rule the more mature organ or individual will be larger than the less mature, but this is not necessarily the case, *e.g.* the thymus, which is actually smaller in the adult than in later childhood.

There are wide differences in the rate of growth of different organs and tissues at different stages of development. This is reflected in the changing proportions of the body during infancy, childhood and adolescence (Fig. 19). Thus in the newborn infant, the head represents approximately one-quarter of the total crown-heel length and the legs (heel to perineum) approximately three-eighths. In the adolescent, the head represents one-seventh and the legs approximately one-half. The same figure shows also that whereas in the newborn infant the umbilicus lies well below the mid-point, it gradually rises in relative position until in the adolescent it lies considerably above the mid-point. The infant is thus short-limbed with a relatively large head and thick trunk, whereas the adolescent is longilinear, with a relatively small head and slender trunk. Although sexual dimorphism of body configuration becomes increasingly obvious with the approach of puberty, differences are recognisable much earlier, since skeletal development is in general more advanced in girls than boys of the same age (see below).

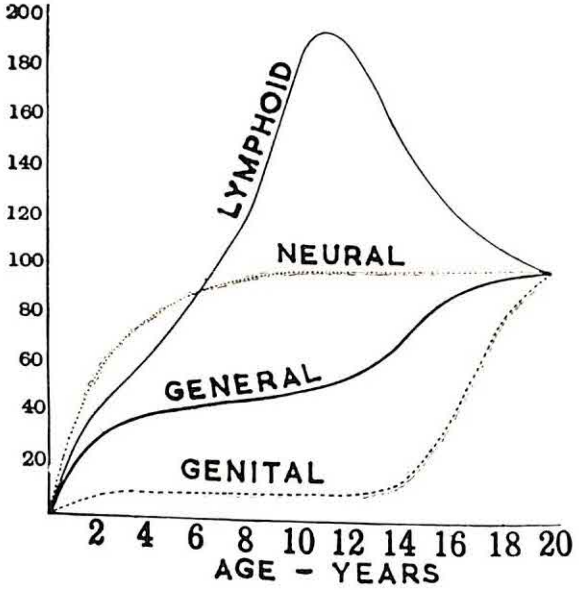

FIG. 20. Graph showing the major types of postnatal growth of the various parts and organs of the body. The several curves are drawn to a common scale by computing their value at successive ages in terms of their total postnatal increments (to twenty years). (After Scammon, R. E., 1930. 'The measurement of man.' Minnesota.)

Pattern of growth. Scammon (1930) has described four distinct types of growth, characteristic of different organs or tissues, which proceed concurrently. These are illustrated in Fig. 20, where each is shown diagrammatically as the percentage increment from birth (0) to maturity (100) in each year of age. The *general* type (heavy unbroken line) is the pattern followed by the body as a whole and by most of its external dimensions with the exception of the head and neck. The respiratory and digestive organs, the kidneys, spleen, musculature, aorta, blood-volume, etc., conform approximately to this pattern, which shows rapid increment during infancy, a slowing-down during childhood, a further rapid increment with the approach of puberty and adolescence, and subsequent deceleration. The *genital* type (broken line), which is characteristic of the testis, ovary, epididymis, uterine tube, prostrate, prostatic urethra and seminal vesicles, shows minimal increment during infancy and childhood followed by rapid growth with onset of puberty. In striking contrast to this, the *neural* type of growth, shown by a dotted line and representing the brain, meninges, optic apparatus and most head dimensions, is characterised by extremely rapid increment during the first four years, reaching nearly 60 per cent of the total at two years and nearly 90 per cent at six years. Subsequent growth from six to twenty years is minimal, representing only 10 per cent of the total increment from birth to maturity, though development (particularly of the cortex) continues more actively than overall growth. The *lymphoid* type of growth (light unbroken line), which characterises the thymus and lymph-nodes, is again radically different from the other three types, since it reaches a maximum greatly in excess of the final increment at ten to twelve years, and there is subsequently an absolute and relative decrease in lymphoid and thymic tissue during the succeeding eight years. A further growth-pattern might be added, *viz.* that of the suprarenals, which lose half their weight in the first two weeks of postnatal life and only regain their birth-weight at puberty.

Whilst it will be realised that diagrammatic representations of these growth-patterns are no more than general approximations, and that growth increments of many of the organs cannot be accurately measured by longitudinal methods during life, they serve to illustrate the important point that postnatal growth is not a simple and uniform process of getting larger from birth to maturity. It is in contrast a highly complex symposium of patterns and rhythms, to which each organ and tissue contributes its quota. The adult is the final result, but the child at any one stage of development differs not only in overall size but in qualitative make-up from what he has been and what he will become.

Factors Controlling or Influencing Growth

Much of our information with regard to the normal control of human growth is deduced from pathological states in which interference with growth has occurred. This has been supplemented by observation of the effects of hormone administration and diet, either experimentally in animals or as replacement therapy in children where deficiency is suspected. Since many experimental procedures are impossible or undesirable in the case of healthy children, and it is often uncertain how far the results of animal experiment are applicable to humans, knowledge of the physiological control of growth is necessarily incomplete. There are certainly many factors in addition to those referred to below which may influence growth, but where the growth potential of an individual child cannot be estimated except within wide limits, it is impossible to assess with any accuracy the various factors which may encourage or impede its fulfilment. Thus climate, season, activity, and a variety of socio-economic and environmental conditions, in addition to diet, play a part in determining the growth-pattern of the individual child, and may well affect adult stature and physique.

Genetic factors. A general control over growth, speed of maturation, and terminal stature is exercised by the genetic constitution of the child. Pygmies will tend to be smaller than Europeans, the negro will tend to have a leg length: stem length ratio which differs from that of the white, tall parents will in general be likely to produce tall children. These genetic influences can undoubtedly be modified by environment, but except under grossly abnormal conditions growth and development, dentition, skeletal and sexual maturation, and cessation of growth will follow lines which are the inherited property of the fertilised ovum. Familial resemblances, which commonly become increasingly obvious during the growth period, are principally the result of genetically-determined growth patterns. Although we may properly emphasise the individual variations in growth which occur between different children, different races, or different socio-economic groups, these are really all subordinate to a more fundamental similarity which is a character of the species.

Nutritional factors. Certain nutritional requirements in excess of maintenance must be met if growth is to proceed at all. In addition to the overall caloric intake, the food factors most intimately related to growth are protein, minerals and vitamins. On the first is dependent the normal functioning of the pituitary, and on the two latter the ossification of the skeleton. Iodine is essential for the development of the thyroid, which in turn plays an essential part in the mechanism of growth.

Of the protein portion of the diet, animal experiments indicate that the amino-acids lysine, tryptophane, histidine, phenylalanine, leucine, iso-leucine, threonine, methionine and valine are all essential for the growth of rats (Macy, 1942), and whilst childhood requirements have not been fractionated in the same detail, it is probable that most if not all of these amino-acids are required by the child for maximum growth. A positive nitrogen balance is necessary to promote growth, but Talbot and Sobel (1947) have pointed out that where the total caloric intake is high, the protein necessary for growth may exceed the maintenance requirements by only a narrow margin. On the other hand, where the total caloric intake is low, the protein requirements will be relatively high in order to provide both for maintenance and growth.

In considering the effects of nutrition and disease on human growth, Acheson (1960) distinguished between (1) continuous adversity resulting not only in slowing of growth but also in stunting of adult stature, and (2) temporary adversity which would also slow growth, but where permanent stunting was uncertain, the temporary slowing possibly being followed by a growth spurt. This 'catch-up' in growth following illness or starvation has been further studied by Prader *et al.* (1963).

Local growth. Since the nutrition of individual organs will be dependent on the blood supply, vascular abnormalities operating during the growth period are liable to diminish or increase growth of the affected organ. Thus binding the feet of Chinese girls resulted in abnormally small feet in adult life, whereas an increased blood supply to a limb due to an arteriovenous aneurysm may cause local overgrowth (Fig. 21).

Emotional factors. It has long been recognised that infants and children may fail to thrive if they are emotionally disturbed, even when the diet offered is theoretically adequate. The adverse effects of unsympathetic handling on the weight-gain of children is one of two German orphanages where rationing was accurately controlled was studied by Widdowson (1951). More recently Patton and Gardner (1963) have reviewed the evidence of growth failure and delayed maturation in children suffering maternal deprivation. Even allowing for the fact that unhappiness or stress may diminish appetite and reduce food intake, or maternal neglect be responsible for inadequate diet, it appears that emotional disturbance itself may affect growth and development, and that supplementing the diet in such cases is apt to be ineffective unless the primary cause is corrected.

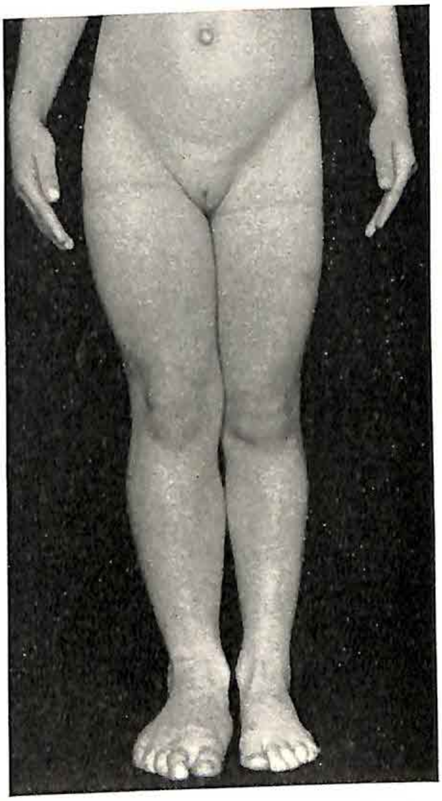

FIG. 21. Overgrowth of right lower extremity due to arteriovenous aneurysm.

Integrity of essential organs. It is a familiar observation that chronic disease of an essential organ, *e.g.* kidneys, gut, heart, lungs, liver, will commonly cause severe interference with growth. This may stem from malabsorption, *e.g.* coeliac disease, or metabolic upset, *e.g.* chronic renal disease, glycogen disease; but where functional capacity of an organ or system is seriously impaired, the body as a whole is likely to show a defective response to growth-stimulus, or this stimulus itself may be impaired. Similarly, if the nerve supply to a particular organ is defective, *e.g.* a limb following poliomyelitis, failure of growth may be limited to the organ unable to respond. General infections are often followed by the appearance of transverse lines of increased density at the ends of the long bones (Harris's lines) which represent transient periods of arrested growth, during which calcium is being deposited but normal bone formation is inhibited.

Endocrine factors. Whilst functional integrity of the whole endocrine system is essential for the completion of the normal growth cycle, the dominating role lies with the anterior pituitary. The production of pituitary growth hormone (PGH) serves as the essential stimulus to growth, except possibly during the first year of life (Talbot and Sobel, 1947). The physiological aspects and clinical use of PGH have been reviewed by Raben (1962), who states 'PGH is distinctive in causing growth of almost all tissues and in increasing size without advancing maturation or promoting sexual development'. It promotes growth in the absence of other pituitary hormones, but is less effective in the absence of thyroid hormone. With the onset of puberty, the action of PGH is further modified by that of the hormones of the gonads and adrenal cortex, which organs are in turn controlled by other hormones of the anterior pituitary. (The role of the internal secretion of the pancreas in influencing growth is probably less direct, though any disturbance of insulin production will have secondary effects on growth.)

For convenience, growth may be divided into two phases, asexual and sexual. The first, asexual, phase lasts until the onset of puberty, and during this phase the gonads have little or no influence on growth. The role of the thyroid is secondary to that of the pituitary, though thyroid deficiency, as in cretinism, results in gross retardation of both growth and development which is only made good by replacement therapy. The administration of thyroid extract to normal children does not stimulate growth consistently, though in thyrotoxicosis occurring in childhood it is sometimes found that height is above the average for age. With regard to the adrenal cortex, it is doubtful whether the several adrenocortical hormones make a significantly positive contribution to the growth-pattern before puberty. Severe deficiency of adrenal cortex will retard growth and hyperadrenocorticism will produce a variety of symptoms depending on the hormone principally involved. In normal children, however, the very small output of 17-ketosteroids during the first eight or nine years of life would suggest that the N hormone of the adrenal cortex (which is related to masculinisation and nitrogen anabolism, and so to growth) is of minimal importance. The sexual, or 'steroid,' phase of growth will be considered in relation to puberty (see below).

The anterior pituitary may therefore be regarded as the endocrine organ primarily responsible for the control of growth in childhood, but depending for its effect on (1) adequate protein and caloric intake, (2) integrity of the endocrine system as a whole and (3) ability of the end-organ to respond to stimulus.

The anterior pituitary, however, is in turn controlled by the central nervous system. The experimental evidence for linking the hypothalamus with the anterior pituitary and the possible method by which the linkage is achieved is fully discussed by Zuckerman (1954). Severe retardation of growth in rats has been shown to follow damage to the anterior half of the median eminence of the hypothalamus, destruction of the pituitary stalk, or isolation of the infundibulum from the hypothalamus (Reichlin, 1960), the findings at least being consistent with the secretion of PGH being controlled by the hypothalamus. Clinical confirmation of control of the pituitary is found in those cases of precocious puberty which are associated with lesions of the central nervous system, *e.g.* tumours of the floor of the third ventricle, some cases of hydrocephalus, or of pineal tumours with secondary hydrocephalus. It would appear that in these cases precocious somatic and genital development is stimulated through the channel of the pituitary rather than by primary abnormality of the pituitary itself.

Sex. Apart from the sexual dimorphism occurring at puberty, sex represents one factor affecting the pattern of growth from conception to maturity. It is recognisable in the smaller average size of female infants at birth, and the subsequent difference in measurements and maturation throughout childhood. Acheson and Hewitt (1954) have suggested, from a study of pre-school children of different economic groups, that boys and girls may also react differently to adverse environmental conditions, the maturation of girls appearing to be less affected than that of boys.

Stages of Development

Although these correlate with growth rather than control it, it is appropriate to describe in general terms the successive stages of development which lie between birth and maturity. The terms used are arbitrary and may carry different meanings in different contexts, *e.g.* the word 'infant' in legal parlance may apply to any individual under twenty-one years of age, whilst in the returns of the Registrar-General 'infancy' refers to the first year of life. For the present purpose, descriptive terms are applied to successive stages of physiological or social development; the pattern of growth appropriate to each stage will be considered subsequently.

The neonatal period is the first month of life (see Chapter 3).

Early infancy may usefully be defined as that period during which the baby is adapted to an almost exclusively milk diet, preceding the eruption of the first dentition and covering approximately the first six months of life.

Later infancy, from approximately six months to two years of age, covers the period of eruption of the first dentition and the acquisition of two major skills, *viz.* walking and speech.

The '*pre-school' period*, from two years to five or seven years is a social rather than a physiological stage of development, during which the child is acquiring an increasing number of skills and a more varied diet; he is extending his social horizon and though this is still largely bounded by the home and his immediate family, he is making excursions outside the immediate range of maternal care and adjusting socially to contact with children of his own age. He is learning primarily through play and through imitation of his elders, but in general is not ready for formal academic education. The physiological termination of this stage may be taken as the beginning of the second dentition.

Childhood (or early school period), lasting from five or seven years to the onset of puberty. This is in some ways a latent period, both as regards growth and emotional development. The major developmental stages of early life have been passed, and those associated with sexual maturation have not yet begun.

Puberty, which occurs at widely different ages in different individuals and on the average two years earlier in girls than boys, represents the period of rapid sexual maturation and growth which terminates childhood proper. It is convenient to recognise at least two stages of sexual development which will be discussed subsequently, namely *pubescence*, lasting from the first evidence of sexual development (commonly breast development in girls, and appearance of pubic hair and/or early genital development in boys) to onset of menstruation in girls (menarche) and a corresponding stage of maturity in boys (see below), and a second stage which is here described as *adolescence*, characterised by deceleration of growth, which finally ceases when full maturity is reached.

Developmental and Skeletal Age

The age of a child described in terms of time-since-birth is known as his chronological age, and is used as a yardstick in defining his date of entry and exit from the educational system, his capacity to undertake employment, his liability to military service, and his capacity to assume civil responsibility including marriage. At the age of eleven his educational future may be irrevocably decided. Yet if a hundred boys of, say, exactly fourteen years of age are grouped together, it will be immediately obvious that there are enormous differences between them, not only with regard to size but also in respect of development is evidenced by musculature, pitch of voice, and hirsuties. If a group of a hundred girls of the same age is added, the developmental differences become even more striking. At the lower end of the scale one may well have a boy who would be mistaken for a child of ten or eleven, and at the other end a girl who would pass for a mature woman. Although the differences are most obvious in the early teens, owing to the widely varying age-onset of puberty and the appearance of secondary sexual characters, they are also recognisable in large groups of infants or children in any one age group. As early as 1906, Crampton put forward the view that 'physiological age' (as distinct from chronological age) was a fundamental conception in studying children. Since then the assessment of developmental age has been very greatly advanced by the aid of radiology and, although well-defined physical landmarks such as eruption of the first and second dentitions, onset of menstruation (menarche) and appearance of secondary sexual characters provide clinical evidence of developmental age, the recent tendency has been to place increasing reliance on skeletal maturation in assessing development. Thus the ossification centre for the lower end of the femur, which normally appears eight to ten days before term, has been given medico-legal importance as evidence of maturity of the foetus. Todd's (1937) 'Atlas of skeletal maturation' represented a most important advance in the systematic study of skeletal age since it provided some 40 male and 35 female standards from the age of three months to eighteen years nine months and sixteen years three months respectively, in the form of radiographs of the hand and wrist, each constituent of the picture being described in some detail. By matching films of individual children against Todd's standards, it became possible to assess 'skeletal age' with reasonable accuracy. Thus a boy of twelve years three months of age whose X-ray of wrist corresponded with Todd's standard 25 would be described as having a skeletal age (S.A.) of eleven years three months, *i.e.* his skeletal maturation would be twelve months behind the standard for his chronological age. Many other workers have since produced independent data on skeletal age, using principally the wrist, knee and ankle as sites of comparative study. Thus Vogt and Vickers (1938) gave diagrammatically three percentile ratings for ossification of the wrist and ankle from birth to six and a half years, and Greulich and Pyle (1959) have published a revised atlas of skeletal development. In using these standards, however, it must be remembered that they are based on North American data which are unlikely to be strictly applicable to other populations, and that allowance must also be made for secular changes. A method of assessing skeletal maturity from radiographs has also been described by Acheson (1954).

Sex-differences in developmental and skeletal age become obvious when large groups of normal boys and girls of similar chronological age are compared. Skeletal maturation in girls (as shown by the average or standard) is found to be consistently in advance of that of boys from birth onward, and skeletal maturity is reached approximately two years earlier. In early infancy the differences are not as great but are clearly recognisable, and throughout childhood there is an average difference of approximately eighteen months. This earlier maturation of girls brings out clearly the distinction between size and maturation. Except for a short period of their lives related to earlier pubertal growth (see below), girls are on the average no larger or actually smaller than boys of the same chronological age although their skeletal development is more advanced. The same is seen in the comparison of radiographs, where in the case of boys, individual bones may be larger than those of girls though the ossification of the hand and wrist as a whole is less advanced.

It has been shown by Simmons and Greulich (1943) that skeletal age in girls correlates more highly with menarcheal age, *i.e.* age of onset of menstruation, than do height and weight, and that girls with early, average or late menarche can be differentiated on assessment of skeletal maturity in advance of menstruation. The same appears to be true of age-onset of puberty in boys, and one can say that, in general, children with advanced skeletal development are likely to reach sexual maturity early, whereas those with retarded skeletal development will mature late.

The relationship of skeletal age to present height has also some prognostic value in estimating 'terminal' or adult height (Bailey, 1946), though it is rather doubtful if the proportion of adult height reached at a given skeletal age is really as constant as has been suggested, even in those children whose skeletal age lies within one year of their chronological age.

Dentition*

The infant and child passes through successive stages of dental development which are directly related to the feeding requirements *viz.* an initial period without erupted teeth, during which he is able to suck and ingest milk but not chew solid food; a period during the eruption of the first dentition when he becomes able to masticate soft solids and subsequently harder foods; and finally, with the gradual replacement of the deciduous dentition by more massive and stronger permanent teeth, he is provided with a dentition capable of biting and chewing a very great variety of animal and vegetable foodstuffs.

The deciduous dentition. The deciduous or 'milk' teeth begin to calcify during the fourth month of intra-uterine life, but calcification is not completed until the fourth year postnatally and the roots are not fully formed until approximately two years after eruption. The complete dentition consists of twenty teeth, *i.e.* four central and four lateral incisors; four canines; four first molars; and four second molars. The time of eruption varies considerably in normal children, and the process of eruption of the crown of a tooth may last from one to three months during which time the gum is often sore or congested. Eruption and shedding of the deciduous dentition tends to be slightly earlier in girls than boys. Average dates of eruption are as follows:

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* Data from Rix, R. E. (1956).

TABLE 9

Deciduous dentition		Date of eruption
Central incisors	upper lower	8th month
Lateral incisors	upper lower	10th month
First molars		12th month
Canines		18th month
Second molars		24th month

The deciduous dentition is gradually replaced by the permanent dentition, the deciduous tooth being lost some months before the eruption of the underlying permanent tooth. As growth proceeds, the lower arch moves forward more than the upper arch, and the changing occlusal relationships of the teeth are shown in Fig. 22.

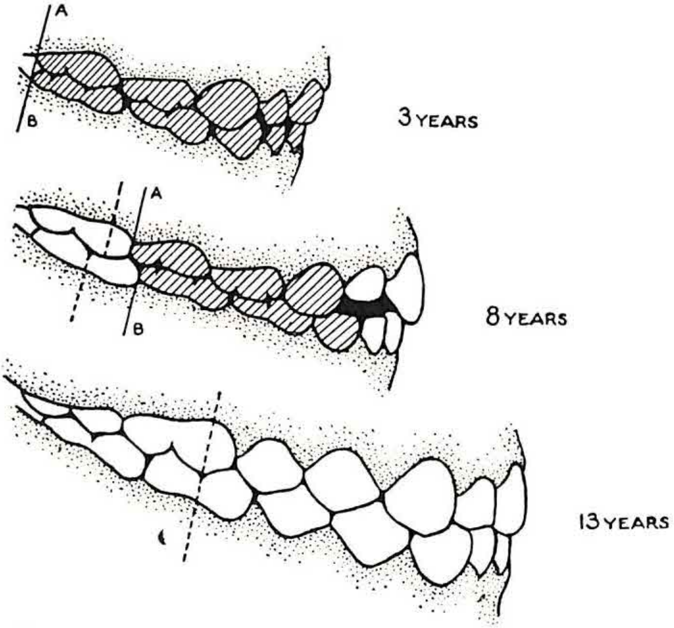

FIG. 22. Changes in the occlusal relationship between upper and lower teeth.

The permanent dentition. This consists of thirty-two permanent teeth *viz.* eight incisors, four canines, eight pre-molars and twelve molars. The incisors, canines and pre-molars replace deciduous teeth. Again there is considerable individual variation in dates of eruption, the following being approximate averages:

TABLE 10

Permanent dentition		Date of eruption
First molars	lower	6th year
	upper	6–7th year
Central incisors	lower	6–7th year
	upper	6–7th year
Lateral incisors	lower	7–8th year
	upper	8–9th year
First pre-molars	upper	10th year
Canines	lower	10–11th year
First pre-molars	lower	11th year
Second pre-molars	upper	10–12th year
Canines	upper	11–12th year
Second pre-molars	lower	11–12th year
Second molars		12th year
Third molars		17–25th year

Structure. The teeth consist of enamel (the hardest of animal substances), dentine, pulp, and cementum, arranged as shown in Fig. 23. The peridontal membrane lies between the cementum covering the roots and the bony socket. The dentine is permeated by branching tubes containing protoplasmic fibrils which represent prolongations of the substance of the peripheral cells of the

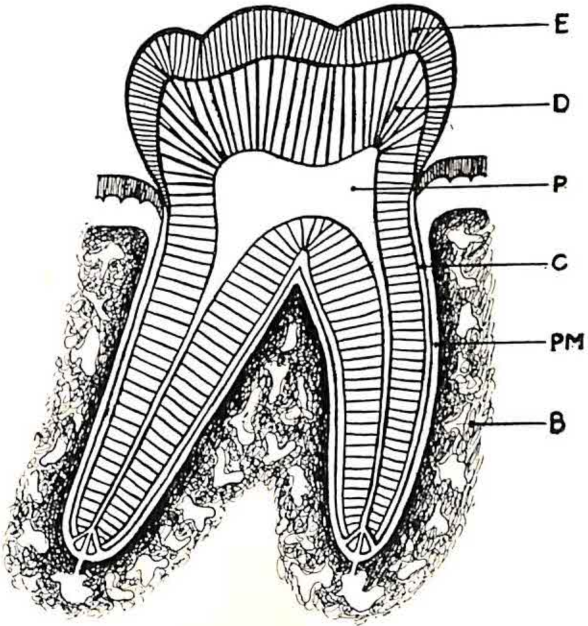

FIG. 23. Diagram of section of a molar tooth. E, enamel. D, dentine, forming the greatest mass of the tooth. C, cementum, a thin layer covering the roots. P, pulp, the small foramina at the apices of the roots permitting continuity with vascular nervous system. PM, peridontal membrane, a thin membrane between the roots and the bony socket, B.

dental pulp. Dentine continues to form slowly on its internal surface, thus gradually reducing the size of the pulp cavity. In the presence of caries involving the enamel, dentine formation serves to protect the pulp.

Cementum also continues to grow slowly throughout life. It is attached to the peridontal membrane by white connective tissue fibres derived from the latter. The pulp is responsible for producing both the organic matrix and the calcific content of the dentine, and maintains the nutrition of the dentine via the dental fibrils.

Methods of Studying Human Growth

A very great deal of information relating to human growth has accumulated during the present century, and more particularly during the past twenty years with the maturing of a number of long-term longitudinal growth studies (see below). Although some of the earlier observations are of little value owing to the techniques used being unreliable or unrecorded, sampling being faulty, or assumptions unjustified, there is now a general tendency to standardise methods and check their reliability, and to present data with detailed statistical analysis.

Several practical difficulties have to be faced in studying human growth. The first is its slowness, a complete study of growth of one individual requiring approximately twenty years. A second difficulty lies in the measuring of small children by techniques which will yield reasonably consistent results in different hands, and in avoiding the introduction of variables which may invalidate results. It has been shown, for instance, that measurements of recumbent length of small children taken at different times of day may show average differences in the same child equalling three months' growth (Kelly *et al.*, 1943). Other factors which are difficult or impossible to control experimentally over long periods include effects of season, diet, changing socio-economic conditions, genetic factors, illness, co-operation of parents and child, and the like. Compared with the investigation of growth in other species, under strict experimental conditions, even the most careful studies of human growth must still be regarded as relatively crude and inaccurate. It should be kept in mind that whilst statistical method can be of the greatest value in arranging sampling, in checking the reliability of techniques, and in analysing and assessing data, it cannot convert faulty observations into good ones, and that as a general rule more valuable information will be obtained by meticulous measurement by trained personnel of small well-selected samples, than by the pooling of measurements made on much greater numbers by many different observers using different apparatus.

Cross-sectional studies. Measurements carried out on stratified samples of healthy children in successive age groups have served to show the mean and the variation of each measurement selected at each age. Ideally, the children forming one age group should be exactly the same age at the time of measurement, *e.g.* tenth birthday. More commonly, a substantial variable as regards age is introduced, and where the age-grouping is by years (*e.g.* children aged ten years and less than eleven years with a 'central age' of approximately ten and a half years) the variation of the measurements will include not only the normal variation between children of exactly the same chronological age, but also a longitudinal variation between children up to six months plus or minus the central age.

The standards provided by cross-sectional data are sometimes described as 'distance standards,' *i.e.* indicating the distance that groups of children have travelled since birth. They have considerable value if their limitations are clearly recognised. It should not be assumed that by constructing a curve from the mean measurement of successive samples one is representing the growth curve of an 'average' child, since even if the successive samples were strictly comparable, such a curve would smooth out the changes in growth rhythm which are characteristic of the individual. Furthermore, there is little value in comparing an individual child with the mean measurement at his own age unless the variation or scatter of the sample from the mean is taken into account. If this is done, one can determine where the child lies in relation to a group of healthy children of the same age. If he comes within the central 66 per cent as regards, say, height, it is of little practical importance whether he is slightly taller or shorter than the average. When he approaches the borderline of normal variation, *e.g.* when 95 per cent of the children are taller than he, the likelihood of his being abnormal increases, since a number of pathologically tall or short children will overlap the two ends of the distribution curve. Again, if the child's relationship to the mean for age changes radically over a period of time, *e.g.* if on first examination he lies easily within the central 66 per cent and a year later lies outside this central group, it can be assumed that he is growing unusually fast or slowly, since children tend to retain their relative position or percentile rating, at least until onset of puberty.

The variation or scatter of measurements around the mean for a particular sample is given by the standard deviation.* In constructing 'standard' composite curves from cross-sectional data, the curve representing the means should show on either side of it the curves representing mean + 1 S.D. and mean − 1 S.D. (or ± 2 S.D. if it is desired to illustrate a wider range.) Alternatively, selected percentile ratings may be substituted. An example of a record card for infants, showing the means ± 1 S.D. for height, weight and head circumference is illustrated in Fig. 24 (Boyd, 1948). Whilst the measurements of no single infant are likely to follow exactly any one of the lines, changes in position in relation to the mean and the ranges indicated are observed readily.

Further uses of cross-sectional data lie in comparing one population with another, such as two different racial or geographic or socio-economic groups. Such data has also made possible the study of secular changes in growth, *e.g.* the comparison of the mean measurements of schoolchildren today with those of schoolchildren of the same city in previous epochs. Recent studies on these lines have all shown that schoolchildren at the present time are both taller and heavier at all ages up to fourteen years than those children for whom comparable data are

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* The standard deviation from the mean is calculated by adding the squares of the deviations of the individual measures from the mean, dividing by the number of observations (or by $n-1$ in the case of small samples) and taking the square root of the result. If the distribution curve of the observations is 'normal', *i.e.* symmetrical, with the mode or peak of the curve corresponding with the arithmetic mean of the series, 68·27 of the observations will lie within a range of plus and minus 1 S.D. from the mean, and 95·45 per cent within plus or minus 2 S.D. from the mean.

In constructing standards, it is important to know whether the distribution curve for a particular measurement is in fact 'normal', since if it is markedly skewed the above relationship will not apply. Most linear body measurements, *e.g.* height, stem-length, span, show an approximately normal distribution curve, but that of weight (particularly in later childhood) is likely to be skewed. To overcome this difficulty, distance standards often include selected *percentile ratings*. Percentile ratings are based on the *frequency distribution* of the measurement, *e.g.* height. The 50th percentile rating is the median measurement of the series. 25 per cent of the observed measurements will be less than the 25th percentile, and 25 per cent greater than the 75th. Commonly the measurements representing the 25th, 50th, and 75th percentile are recorded, but the 3rd, 10th, 90th and 97th are sometimes added. The relative merits of using standard deviations and percentile ratings are discussed by Tanner (1952).

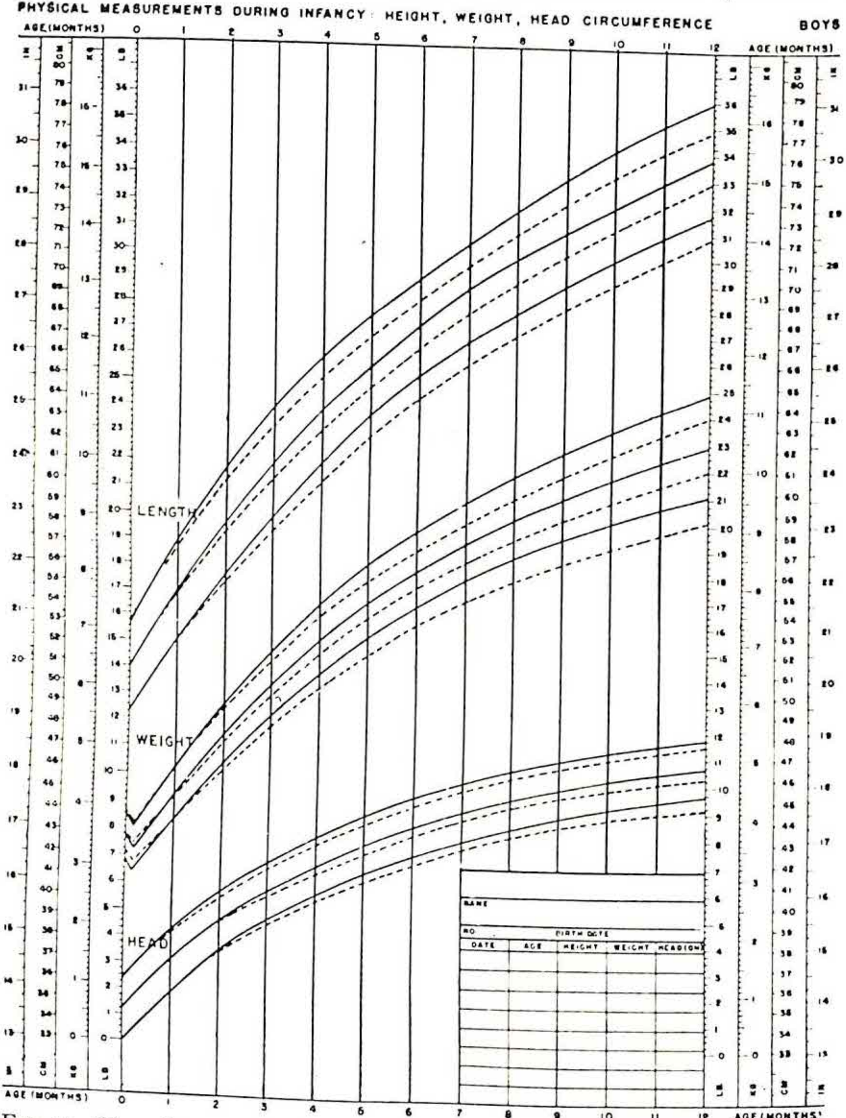

FIG. 24. Chart for recording length, weight and head circumference of infants. The solid lines represent curves for growth for the standard population of male infants from birth through to the twelfth month. For each dimension, the middle curve indicates the average value for age. The upper and lower curves (mean ± 1 S.D.) bound the range of values observed for approximately two-thirds of the standard population. The broken lines show superimposed the corresponding values for females. (From Boyd, J. D. 1948. *Amer. J. Dis. Child.*, **76**, 53.)

available in earlier generations. This is well demonstrated by the mean heights and weights of London schoolchildren, when more recent measurements are compared with those of 1905–12 and even those of 1939 (see Fig. 25). Over a period of forty years, an average increase of approximately 3 in. (7·5 cm.) in height and 9 lb. (4 kg.) in weight was observed in London schoolboys (Weir, 1952). A detailed study of the anthropometric data on British children from 1883

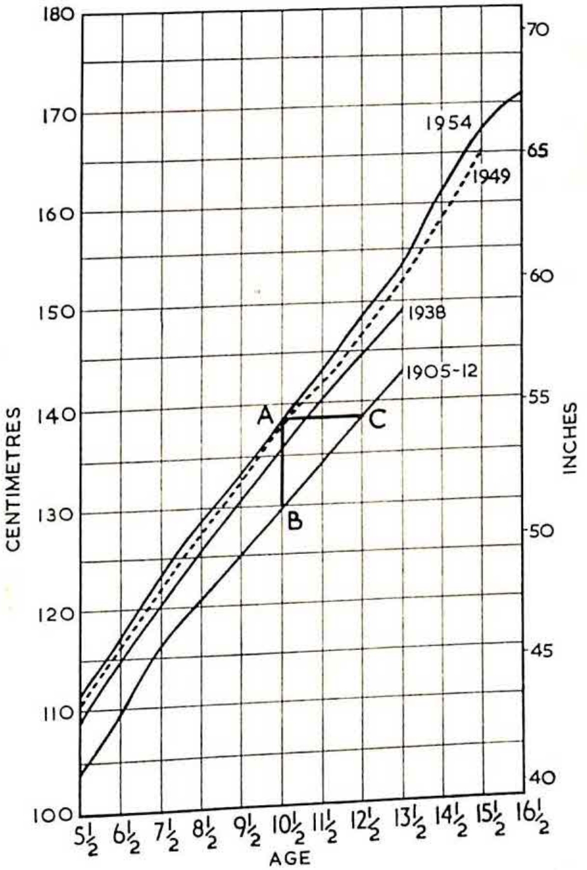

FIG. 25. Average heights of London schoolboys in 1905–12, 1938, 1949 and 1954 (L.C.C. figures). AB shows increase in average height at 10½ years. AC shows that the average height of a boy of 10½ years in 1954 was that of a boy of 12½ years in 1905–12.

(British Ass. Anthropometric Survey) to 1947 was made by Clements (1953), confirming the general increase in average weight and stature which represented an acceleration of eighteen months' growth, *e.g.* an average child of six years being of similar size to one of 7·5 years in 1880. The difference in both height and weight of children of upper and lower income groups had been gradually reduced, though not altogether eliminated. Weir (1952) had previously investigated the changes in growth pattern, first in terms of age of attainment of a given weight or height (Fig. 25) and secondly in terms of rate of growth, and had also reached the conclusion that the observed changes were essentially due to an acceleration. There is in addition evidence that this acceleration of growth is associated with earlier sexual maturation. Thus the median age of menarche of Edinburgh schoolgirls was found to be 13·49 years in 1951–53 (Provis and Ellis, 1955) compared with a mean of 15·04 years for Edinburgh women who had been schoolgirls at the beginning of the century (Kennedy, 1933), *i.e.* an acceleration of approximately eighteen months. The fact that children reach a given height or weight (or stage of maturation) at an earlier chronological age than in the earlier part of the century does not, however, mean that terminal height is necessarily increased to the same degree. Earlier maturation also results in earlier deceleration and cessation of growth. The available British evidence (Boyne, 1960) does, however, indicate a secular increase in average height, confirmed by French, Swiss and Scandinavian data. Whilst the increase is most marked in the lower income groups, it cannot be interpreted as due solely to improved socio-economic conditions or to the elimination of pathological states such as rickets which produce stunting. It is probable that out-breeding of previously isolated communities has also been a significant factor in increasing average adult stature (Hulse, 1957; Broman *et al.*, 1942). We are here presumably seeing the interplay of two factors, genetic control and environment. Whilst improved socio-economic conditions can accelerate maturation and the speed and effectiveness with which the growth potential of an individual is fulfilled, their effects are limited by the genetic control to which growth potential is subject.

Longitudinal studies. In contrast to cross-sectional studies, longitudinal studies measure the growth of one or more individuals over a period of time. The introduction of the time-factor makes it possible to study the velocity of growth and also its acceleration or deceleration at any given age or phase of development. Growth increments during known periods, *e.g.* years of age, can be measured and standards of increment calculated in terms of the mean and standard deviation. By comparing these with the growth increments of an individual child between, say, the age of eight and nine years it is possible to say whether he has grown faster or more slowly than the average during this time, and when his growth during the previous and subsequent years is known, whether his growth is accelerating or decelerating during that year. Whilst there is no question that longitudinal studies can provide direct information about growth which can only be deduced indirectly or not at all from cross-sectional data, there are many practical difficulties in the long-term study of the same group of children for a number of years, and more particularly from birth to maturity. These include unbiased sampling in the first instance, loss of subjects during the investigation, changes of personnel, and expense. Nevertheless a number of North American studies on these lines have been completed (Tanner, 1948) and there are several British studies, including the Oxford Child Health Survey, the Child Study Research Project (Moore *et al.*, 1954), and one at the National Children's Home, Harpenden (Tanner, 1952). Many investigators have carried out short-term longitudinal studies related to a particular age-period or phase of development, or have combined longitudinal and cross-sectional data. Thus if all the children remaining in one school are measured twice at a year's interval, data will be obtained on the growth increment of group A from five to six years, of group B from six to seven years, etc. It will also be shown how closely the mean measurements of group A at six years correspond with those of group B at the same age, an important point in interpreting cross-sectional data. Again, if groups of children of known birth-weight are compared at a given age, a longitudinal factor as regards weight is introduced into the cross-sectional data. The subsequent development of infants of low birth-weight is discussed in Chapter 4.

Growth of the individual child. It has already been mentioned that 'growth curves' composed from the means of cross-sectional data will tend to smooth out the alterations in growth rhythm which are characteristic of the individual. These latter are illustrated in Figs. 26 and 27 which show the height and weight

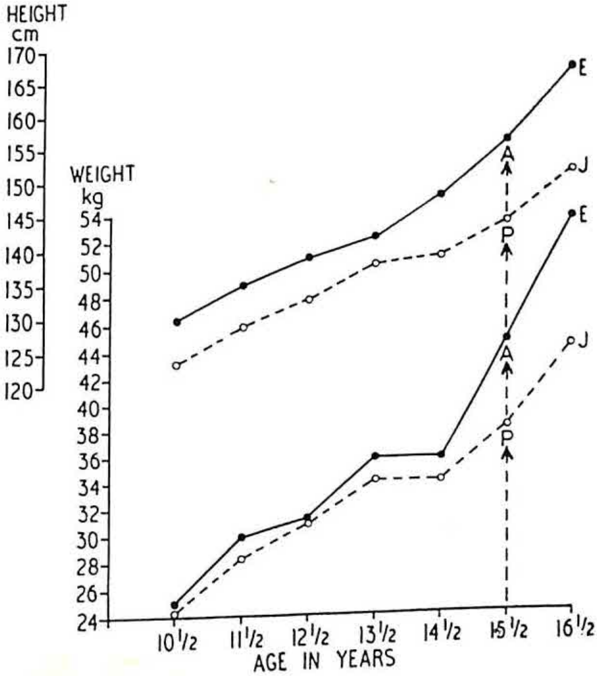

FIG. 26. Growth curves (height and weight) of twin boys over a six-year period. (A = adolescent and P = pubescent maturity grading.)

of twin boys, and annual increments in each, over a period of six years. The boys, who had never been separated, had been in the same residential school since the age of ten, and had been measured annually on the same day and at the same time of day when six and a half, seven and a half, etc. Both genetic constitution and environment were thus as closely comparable as is possible with human material. Maturity-grading at the age of fifteen and a half years and again eight months later, however, showed more advanced maturation in twin E on both occasions (twin E 'adolescent,' twin J 'pubescent'). Comparison of the two figures shows that although the earlier maturing twin E was taller and heavier than twin J at all ages, height increment was almost identical between the ages of ten and a half and eleven and a half, and eleven and a half and twelve and a half. With the earlier maturation of twin E, the curves diverge after the age of fourteen years, *i.e.* the pubertal spurt of growth appears approximately a year earlier in twin E. It will also be seen that weight-increment is much more erratic than height-increment. Thus in one 'lean year' at the age of thirteen and a half to fourteen and a half (which was in fact 1944–45 when rationing was most rigorous), both boys failed to gain weight, though growth in height of the twin E who was reaching puberty continued undiminished. Again, however, the earlier onset of puberty in twin E is reflected in the height and weight-gains between fourteen and a half and sixteen and a half years.

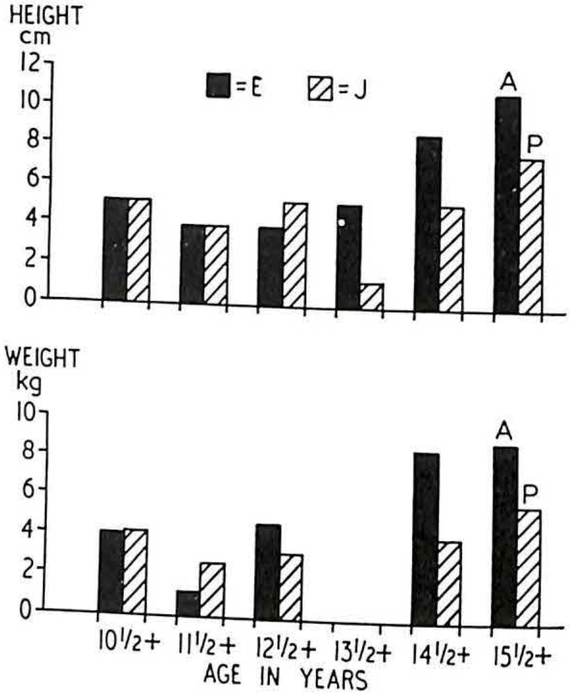

FIG. 27. Annual increments of height and weight of twin boys over a six-year period. (A = adolescent and P = pubescent maturity grading.)

Anthropometric Methods

The routine measurement of infants is often limited to weighing, and of schoolchildren to measurement of erect height and weight. Weight alone gives little indication of what is being weighed—bone, muscle, fat, or water—whilst measurement of erect height is open to gross error unless care is taken to position the child correctly. Nevertheless these two measurements, taken accurately, and considered together, are of considerable value in assessing the progress and well-being of the individual child. It is not proposed to consider the various indices, *e.g.* that of Tuxford (1942), which have been based on height and weight. Some of these relate H to $\sqrt[3]{W}$ or H^3 to W, since height is a linear measurement and weight one of mass. During childhood (from approximately five years to puberty), weight increases logarithmically with increase in height, and some authors now prefer to plot log weight against height over this age-range when only the relationship of weight and height is being considered. From the early Baldwin-Wood tables showing the expected weight-for-height at each age, have been evolved a variety of methods of recording height, weight and age in order to show graphically whether a particular child is progressing normally within his expected growth channel. Of these the Wetzel grid (Wetzel, 1941) is one which has been widely used in North America, but has been the subject of brisk statistical criticism. For a detailed discussion of methods of recording growth data, see Tanner (1951, 1952).

The measurements selected will depend on the purpose for which they are intended. If it is desired to assess the individual infant or child against either distance or velocity standards, calculated from a comparable population, preference will be given to a few selected measurements which can be determined accurately and which will at the same time give information with regard to length, mass, and width or girth. The value of different measurements may be found to vary with age. Thus head-circumference, which is a useful measurement during infancy when neural growth is proceding with great rapidity, is of less importance during childhood and adolescence. Maturity-grading, on the other hand, becomes of greatest value with the approach of puberty.

If the measurements are intended for the study of growth as such, it will be necessary to select those which will indicate not only overall size, but the contribution made by the various body components at each age, *e.g.* the ratio of stem-length to total length, and also individual body build. Unfortunately there is as yet no universal agreement either on the measurements used in different studies or on the techniques to be adopted. The following comments apply to some of the measurements most widely used in paediatric practice.

Linear measurements. The most essential linear measurements are those of erect height and/or recumbent crown-heel length; sitting height and/or recumbent crown-rump length. Direct measurements of the upper and lower limbs, and their components are commonly included in studies of growth but are of less value in assessing the individual child.

Erect height. This should be measured against a flat surface, and the child encouraged to stand as upright as possible without lifting the heels from the ground. The heels should be slightly separated and the weight borne evenly on both feet. Heels, buttocks and dorsal region are brought in apposition with the upright surface and the head positioned so that the child is looking directly forward, with the Frankfort plane (external auditory meatus to lower margin of orbit) and the bi-auricular plane horizontal. A sliding headpiece is brought down sufficiently firmly over the vertex to compress the hair; care must be taken that the child does not flex the knees as this is done. Readings should be recorded to the nearest $\frac{1}{4}$ in. or 0·5 cm.

Whilst erect height is the measurement most commonly used for school-children, it is inapplicable to infants and unsatisfactory in pre-school children. Even in the older age groups it is subject to considerable diurnal variation, being greater in the morning than in the evening, and errors due to fatigue and faulty posture may be impossible to overcome completely.

Recumbent (crown-heel) length. The infant or child is placed supine on the measuring table (see Fig. 28), the feet firmly in position against an upright foot-board. With the child lying straight, any flexion of the knees or arching of the back is overcome and the head positioned in the midline, with the Frankfort plane vertical. A sliding head-piece is brought into firm contact with the vertex, and the length measured as in the case of erect height. It will be found that an assistant is usually required for the accurate measurement of infants, and time and patience for that of pre-school children. In the case of older children, the measurement of recumbent length is in many ways more satisfactory than that of erect height, as it tends to reduce errors due to fatigue and posture, which affect boys and girls (particularly adolescents) unequally. Recumbent length is slightly greater than erect height. Palmer (1932) has produced conversion tables for measurements of supine length from 80 to 180 cm. for both sexes. On the average, supine length of boys from 110 to 180 cm. exceeds erect height by 0·5 cm., the corresponding figure for girls being 1·1 cm. In pre-school children, subtraction of 1 cm. from supine length will give a close approximation to erect height for both sexes.

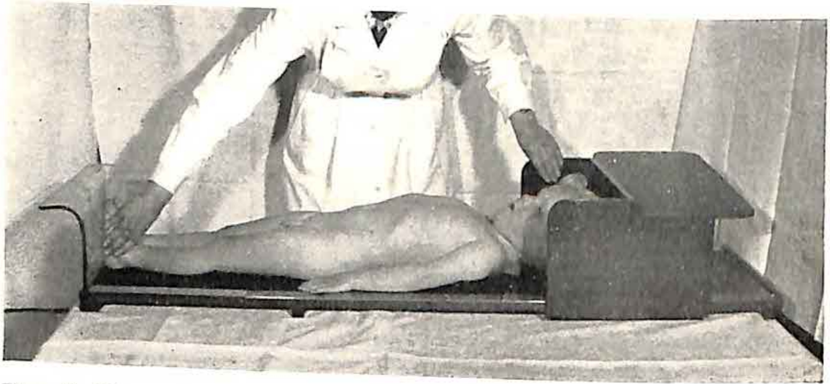

FIG. 28. Measuring recumbent length of a pre-school child. Measuring-board has perspex foot-piece and sliding head-piece with lateral flanges to prevent rotation; steel measure set in base. (Dr. J. Thomson.)

Sitting height. The child sits on a box of known height (*e.g.* 10 ins. or 25 cm.) with knees apart and ankles crossed. The sacrum and dorsal region are placed in apposition to the measuring board, and measurements taken as for height.

Recumbent crown-rump (*Stem*) *length*. The child is placed on the measuring table with the ischial tuberosities against the foot-board and with the thighs and knees flexed at right angles. Measurements are then made as for recumbent crown-heel length.

Lower-limb length. In place of direct measurement of lower limb length, the subtraction of sitting height from erect height (or of recumbent stem-length from recombent crown-heel length) will be equally informative for most purposes.

Span. This can be measured in the erect position against a horizontal grid, the child standing upright with the arms abducted to a right angle from the trunk, the forearms supinated and the fingers extended. The measurement is taken from mid-finger-tip to mid-finger-tip. Alternatively, the child can be placed supine across the measuring board so that the abducted arms are in the long axis of the board. If the biacromial diameter of the chest (see below) is subtracted from the span, the result will represent approximately twice the length of the upper extremity.

Comparison of linear measurements. Fig. 29 shows graphically the means of three

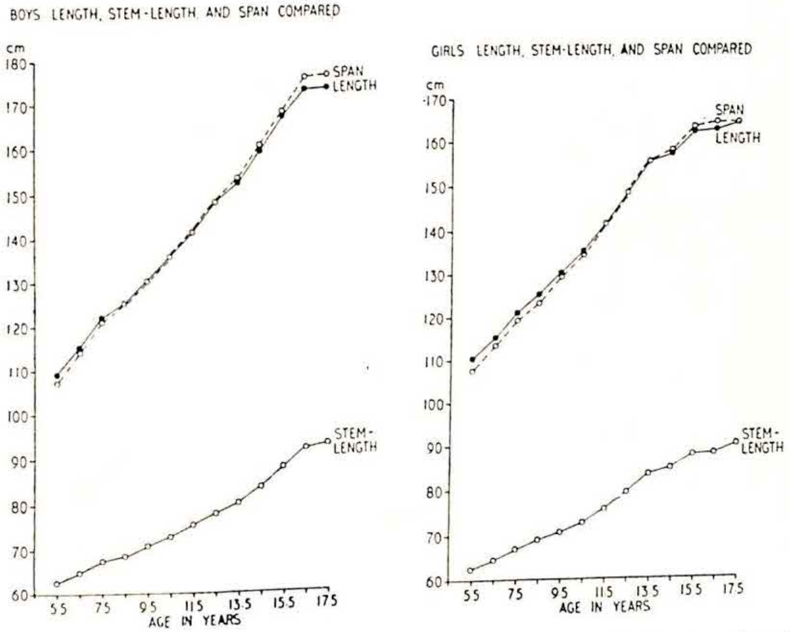

FIG. 29. Comparison of means of three linear measurements (recumbent length, recumbent stem-length, and span) of Edinburgh schoolchildren. (From Provis, H. S. and Ellis, R. W. B., 1955, *Arch. Dis. Childh.*)

linear measurements (recumbent length, recumbent stem-length and span) of samples of Edinburgh schoolchildren aged five to eighteen years. It will be seen that whilst span is of the same order as total length, it is in both sexes slightly less than total length in the younger age groups and slightly greater in the older children. A much greater age-difference is seen when total length is compared with stem-length, the two curves diverging with increasing age, *i.e.* stem-length representing a progressively smaller proportion of total length in each age group due to the more rapid growth of the lower extremities.

Measurements of width. Biacromial width and pelvic width should be measured with calipers, the child standing erect, and the tips of the calipers being fitted firmly against the bony points. Pelvic width is measured either as the intraspinous width (taking the anterior superior iliac spines as the bony points), or, perhaps more commonly, as intercristal diameter. In the latter case, the calipers are fitted to the most lateral point of the crest of either ilium, using firm pressure.

Comparison of the biacromial width and intraspinous pelvic width (Fig. 30) shows well-marked sex differences, shoulder width diverging from pelvic width to a much greater extent in older boys than in girls.

Weight. This should be measured on a beam-balance with platform. The child stands evenly on the centre of the platform, care being taken that no part of the body other than the feet is touching the balance or wall. Balances should be regularly checked and adjusted if necessary. The recorded weight should represent naked weight. Younger children should be weighed nude, and older children in a standard garment, the weight of which is subtracted from the total weight.

Circumferential measurements. These include head circumference in infants and pre-school children; chest circumference; and leg girth. (Measurement of abdominal circumference is so unreliable that it is seldom used.) Each measurement should be taken with a steel tape with millimetre scale; if a cotton tape is used, it must be frequently checked for stretching or shrinkage.

Head circumference is measured at the level of the most prominent part of the occiput and immediately above the supraorbital ridges, firm pressure being applied. This measurement is of most value before the age of five years, and is not usually included during school-age when neural growth is minimal.

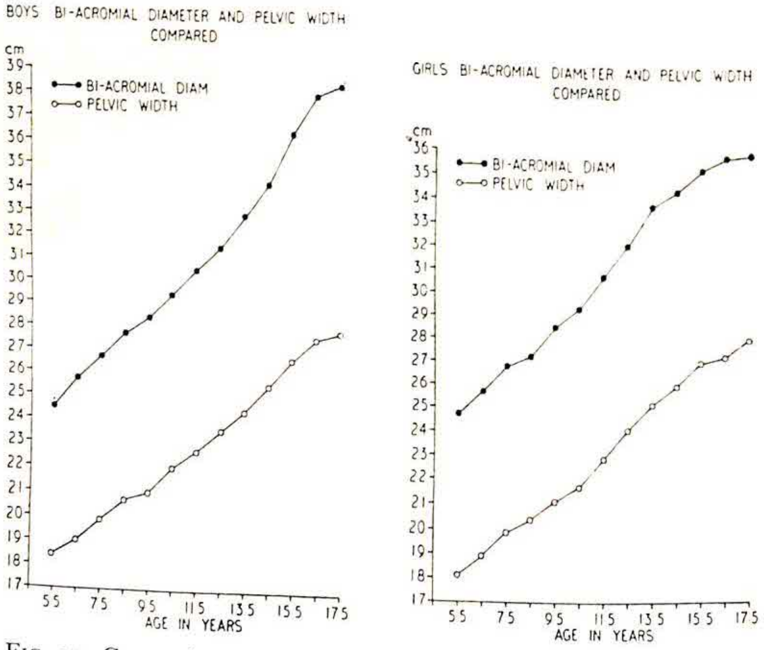

FIG. 30. Comparison of mean measurements of biacromial diameter and intraspinous pelvic width of Edinburgh schoolchildren. (From Provis, H. S. and Ellis, R. W. B., 1955, *Arch. Dis. Childh.*)

Chest circumference should be measured in the recumbent position, with the chest midway between expiration and inspiration. It is impossible to standardise the measurement completely, and considerable experimental error is to be expected.

Leg girth is taken as the maximum circumference of the calf, when the child is standing with feet apart and the weight evenly distributed.

Skin and subcutaneous fat. Stuart and Meredith (1946) recommended assessment thickness of skin and subcutaneous tissue in two situations, *e.g.* below and lateral to the inferior angle of the scapula and immediately above the crest of the ilium (or over the triceps). The thumb and index finger are placed 3 cm.

apart and a double layer of skin and subcutaneous tissue elevated by approximating the thumb and finger. The measurement should be made with special calipers, *e.g.* the Harpenden skin fold caliper designed to exert a pressure of 10 g./sq. mm. on the skinfold face at all openings up to 40 mm. Tanner and Whitehouse (1962) give standards for skinfold thickness measured over the triceps and below the scapula from birth to sixteen years of age. The left side of the body is used by convention.

Body-build. Sheldon *et al.* (1940) have described a method of *somatotyping* adults based on a standardised technique allowing measurements to be made from photographs of the subject posed in three positions. Recognising that every individual possesses to some degree three types of build (described as *endomorphy*, *i.e.* showing soft, rounded contours; *mesomorphy* or muscularity; and *ectomorphy* or linearity), each subject is assessed on a seven-point scale for each component.

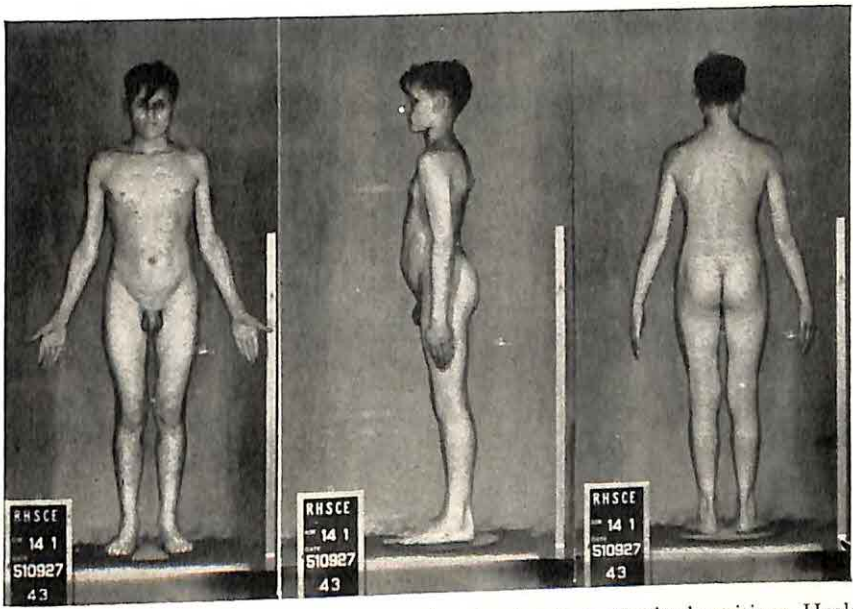

FIG. 31. Subject posed for somatotyping, showing the three standard positions. Heels are placed 4 cm. apart and feet everted 10°; hands held away from sides to allow clear view of body contour. Subject rotated on turntable. Boy aged 14 years 1 month. Maturity grading pubescent (early genital development with minimal pubic hair). (Courtesy of Dr. J. O. Craig.)

Although the same descriptive terms are often used for children, it cannot be said that numerical somatotyping before terminal stature has been reached can be regarded as scientifically reliable, or that somatotypes remain strictly constant. However, photoscopy, or the examination of photographs taken in standard positions (Fig. 31), using a technique which eliminates photographic distortion (Dupertuis and Tanner, 1950) has added a valuable method of general appraisal of body-build which supplements anthropometry. With the onset of puberty, clinical assessment of the stage of maturity reached should be included in the records of the examination. The criteria for grading will be discussed subsequently (Chapter 7).

Status at birth

The size of the infant at birth represents the product of the duration and rate of his growth during prenatal life. Birth-size will already have been influenced by a number of the factors referred to above, *e.g.* sex, nutrition and heredity, including race. There is also a tendency for birth-size to increase with birth rank so that first-born infants are likely to be significantly smaller than later-born infants of the same parents. Again, the rate of growth of multiple foetuses (twins, triplets) is slower than that of singletons after approximately the 27th week of pregnancy (McKeown and Record, 1952). The duration of gestation is of even greater importance, since premature birth will be evidenced by small size and immaturity, the degree of both depending on the degree of curtailment of the normal period of prenatal growth and development (see Chapter 4).

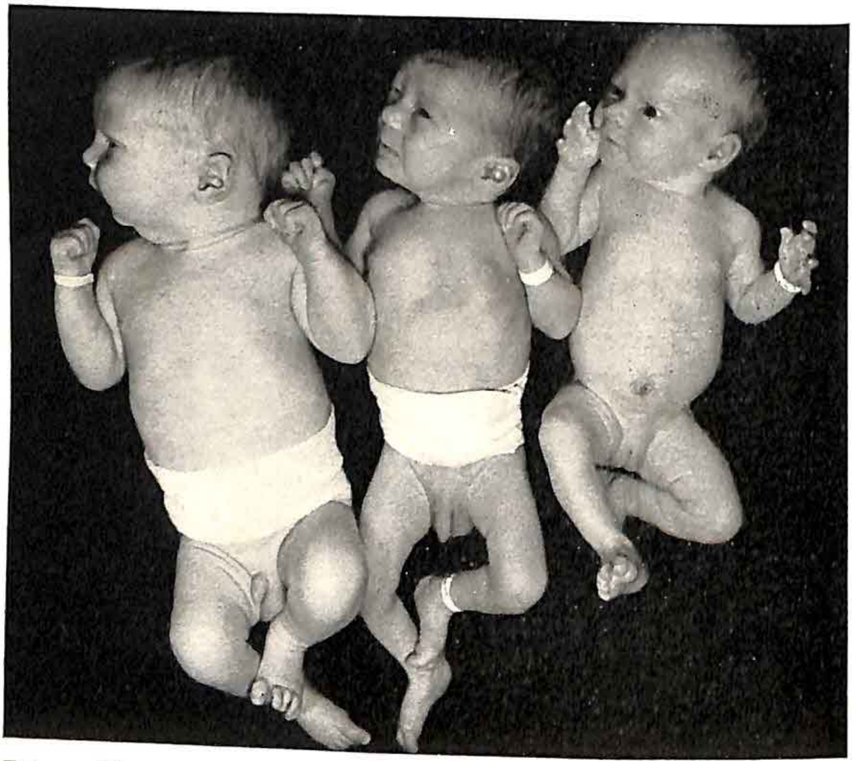

FIG. 32. Three normal full-term infants aged one week, weighing $12\frac{1}{2}$ lb., $7\frac{1}{2}$ lb. (average), and $5\frac{1}{2}$ lb. respectively.

Gestational age. It is seldom possible to determine the date of conception except in relation to the menstrual history of the mother. Ovulation normally occurs fourteen days before the first day of the next (expected) menstrual period and conception is only likely to occur within three days of ovulation. The normal gestational age of the foetus is calculated as 280 days from the first day of the last menstrual period, *i.e.* that preceding ovulation. Even when menstruation has been regular and the cycle of normal duration, this calculation can only be regarded as accurate to ± 1 week. Errors of a month are occasionally introduced when a period has been missed immediately before conception, or when post-conceptional bleeding occurs at the time of the next menstrual period.

Birth-weight of full-term infants. In any large series of full-term infants it will be found that there are very big variations in birth-size between otherwise normal infants, and that the largest infants will weigh double, or more than double, the smallest (Fig. 32).

The distribution curves of weight for 243 male and 209 female infants of mixed birth-rank born at term in the same Edinburgh hospital (Ellis, 1951) are shown in Fig. 33.

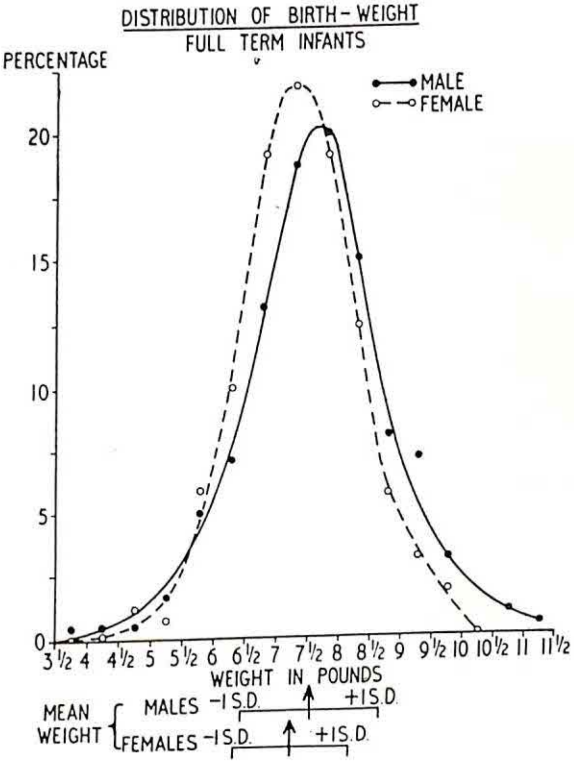

FIG. 33. (From Ellis, R.W.B., 1951.)

It will be seen that the distribution curves are approximately regular and symmetrically distributed about the mean, and that females tend to be smaller than males, the female curve lying to the left of the male curve. The means for the two groups were: males 7 lb. 9 oz. (3·44 kg.) with a standard deviation of 18 oz. (514 g.): females 7 lb. 4 oz. (3·32 kg.) with a standard deviation of 15 oz. (423 g.). These values may be compared with Boyd's (1948) North American figures, *viz.*: mean birth-weight males $7\frac{3}{4}$ lb. (3·5 kg.) with S.D. 14 oz. (400 g.) and mean birth-weight females, $7\frac{1}{2}$ lb. (3·4 kg.) with S.D. 14 oz. (400 g.).

A comparison made in the same Edinburgh hospital between first-born infants of mothers in Social Class III and Social Class V showed that the mean birth-weight for both males and females were slightly but significantly lower in the lower income group. The mean birth-weights of African infants are again substantially lower, though no valid conclusions can be drawn from this finding as to the relative importance of race and maternal malnutrition in influencing birth-weight.

Diabetes, or the pre-diabetic state, in the mother is liable to produce giant infants, and the maternal condition may sometimes be suspected before it has become clinically obvious by the birth of one or more infants weighing over 10 lb. at birth. Indeed, a history of overweight births should be regarded as an indication for a glucose-tolerance test on the mother to exclude a diabetic or pre-diabetic state.

Weight-loss during the first three days of life is physiological.

Birth-length of full-term infants. Measurements of crown-heel (CH) and crown-rump (CR) length in the neonatal period are of little value unless carried out by trained observers using a suitable measuring board (Fig. 29), and paying particular attention to positioning. Crown-rump length is measured in the same way as that described for recumbent length, but with the infant's ischial tuberosities placed against the foot-piece of the measuring-board, with the thighs and knees flexed at a right angle. Since the newborn infant tends to adopt the intra-uterine position with flexed limbs, it is sometimes easier to obtain an accurate measurement of CR length than of CH length. CR is approximately two-thirds of CH in the newborn, though a more accurate relationship is given by Scammon and Calkin's formula (1929) when both are expressed in cm. *viz.* CR = 0·66 CH + 0·5.

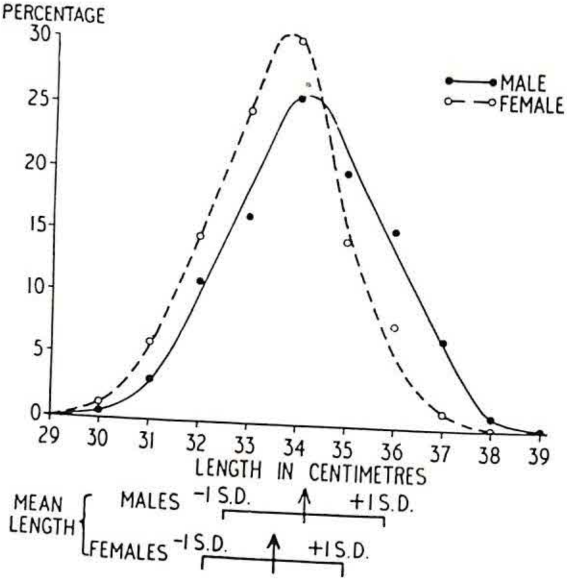

FIG. 34. Distribution of CR length of full-term newborn infants. (From Ellis, R. W. B., 1951.)

The mean CH and CR lengths in the Edinburgh series (Ellis, 1951) are shown in Table 9 and the distribution of CR lengths in Fig. 34.

The mean CH lengths are comparable with Boyd's (1948) data. Few authors have recorded figures for CR length in full-term newborn infants, but since CR is frequently used in measurement of the foetus, and sitting height included in the measurements of the older child, it might well be included in the full assessment of the newborn.

Prematurity (see Chapter 4). A number of authors have suggested other measurements in addition to birth-weight as indications of prematurity, *e.g.* crown-heel lengths of 47 cm. (18½ in.) or less (Dunham, 1948), head circumference less than 33 cm. (13 in.) and crown-rump length less than 32 cm. (12⅝ in.) Although it has been shown in the case of foetal lambs that measurements of crown-rump length show considerably less scatter than those of weight in the latter part of pregnancy (Barcroft, 1946), it has not been established that in surviving premature infants crown-rump length alone provides a substantial improvement on weight alone as an index of prematurity (Ellis, 1951). It would appear, however, that when two out of three measurements (*e.g.* weight, head circumference, and CH or CR length) are used together as indications of prematurity, there will be fewer misfits than when weight is used alone.

Postmaturity. Although the obstetric risks of postmaturity are well known (McKiddie, 1949), and include foetal distress, difficult delivery and anoxia, the physical status of the postmature infant after birth has received less attention. Ballantyne in 1902 noted the association of postmaturity, desquamation, and absence of vernix, and referred to senility of the placenta in these cases, whilst Clifford (1945) and Taylor *et al.* (1952) found that yellow-staining of the vernix, not due to haemolytic disease, was associated with post maturity in 20 per cent and 30 per cent of cases respectively. Clifford (1954) described the postmaturity syndrome in more detail recognising three stages. In the first stage, loss of vernix resulted in the skin appearing dry or cracked, whilst the infants were open-eyed and alert; they appeared 'malnourished' although the average weight was 7 lb. 6 oz. In the second and third stages, discharge of meconium into the amniotic fluid had resulted in an increasing degree of yellow staining of the vernix, skin, nails and cord. Clifford concluded that the syndrome is related to placental dysfunction due to senescence after term is reached; that postmaturity (taking a gestational age of over 300 days) has an incidence of approximately 5 per cent, corresponding with the findings of Kortenoever (1950), and that the major degrees of postmaturity carry a high foetal mortality. His figures suggest that the postmature infant does not increase significantly in weight after term is reached owing to functional insufficiency of the placenta, but that some growth in length continues. Increased length and head circumference, associated with advanced ossification, were also noted by Ballantyne (1902) and Ballantyne and Browne (1922), and continued growth and hardening of the foetal head between forty and forty-four weeks' gestation has been confirmed by Macdonald (1954).

Growth and Development during Infancy

During the first two years of postnatal life, the infant grows rapidly but at a speed which is constantly decelerating. If his postnatal growth is compared with the growth of the foetus (Fig. 3) it will be seen that, in the case of the full-term infant, the highest velocity of growth is reached during the last three months of intrauterine life, and that each subsequent three month period is characterised by a slower rate.

Table 11 shows the mean weights and lengths of full-term singleton first-born infants of both sexes during the first year of life (cross-sectional data).

TABLE 11

Crown-heel and Crown-rump Lengths of Newborn

	CH				CR			
	Mean (in.)	S.D. (in.)	Mean (cm.)	S.D. (cm.)	Mean (in.)	S.D. (in.)	Mean (cm.)	S.D. (cm.)
Males .	19·98	0·77	50·71	1·95	13·45	0·62	34·26	1.55
Females .	19·62	0·82	49·80	2·08	13·22	0·54	33·59	1·36

TABLE 12

Crown-heel Lengths and Weights of Full-term First-born Singleton Infants During the First Year of Life (Means and S.D.)

(From cross-sectional data of Dr John Thompson, 1955)

BOYS

Age weeks	Length in.	S.D. in.	Length cm.	S.D. cm.	Weight lb. oz.	S.D. oz.	Weight kg.	S.D. kg.
2	20·4	0·8	51·7	2·0	7 8	14	3·41	0·39
4	21.0	0·7	53·3	1·9	8 8	18	3·84	0·52
8	22·3	0·8	56·6	2·1	10 8	22	4·76	0·61
12	23·5	0·8	59·7	2·0	12 8	23	5·67	0·66
16	24·4	0·6	62·0	1·6	13 15	25	6·32	0·72
20	25·2	0·8	64·0	2·0	15 6	26	6·98	0·73
24	25·9	0·8	65·8	2·0	16 12	28	7·60	0·81
28	26·5	0·8	67·4	1·9	17 15	31	8·14	0·88
32	27·1	0·8	68·8	2·0	18 5	31	8·59	0·87
36	27·7	0·7	70·4	1·7	19 5	29	9·04	0·82
40	28·2	0·8	71·5	2·1	20 9	30	9·31	0·86
44	28·7	0·9	72·9	2·2	21 7	34	9·71	0·97
48	29·1	0·9	73·9	2·3	22 2	38	10·04	1·09
52	29·6	0·9	75·1	2·3	22 12	38	10·33	1·08

GIRLS

Age weeks	Length in.	S.D. in.	Length cm.	S.D. cm.	Weight lb. oz.	S.D. oz.	Weight kg.	S.D. kg.
2	20·1	0·8	51·0	2·0	7 5	15	3·32	0·43
4	20·7	0·8	52·5	2·0	8 3	15	3·71	0·44
8	21·9	0·8	55·7	1·9	10 1	17	4·55	0·49
12	22·9	0·7	58·3	1·9	11 11	21	5·29	0·59
16	23·8	0·7	60·4	1·8	13 4	21	6·00	0·60
20	24·5	0·6	62·3	1·5	14 7	24	6·56	0·69
24	25·3	0·8	64·1	2·0	15 11	28	7·11	0·81
28	25·9	0·8	65·7	2·0	16 13	29	7·64	0·83
32	26·5	0·9	67·3	2·2	17 14	32	8·12	0·92
36	27·0	0·9	68·7	2·2	18 11	32	8·46	0·92
40	27·5	0·8	69·9	2·1	19 7	33	8·81	0·93
44	28·1	0·9	71·3	2·3	20 6	36	9·23	1·03
48	28·6	0·9	72·5	2·4	20 15	38	9·49	1·07
52	29·1	1·0	73·9	2·6	21 11	38	9·84	1·07

Weight. After the initial loss in the newborn period, the infant gains on the average 10 lb. (4·5 kg.) during the first six months of life. Within wide limits, the weight increments of infants of the same sex tend to be independent of birth-weight. Thus, an infant weighing 6 lb. at birth might be expected to weigh approximately 16 lbs. at six months, and one of 9 lb. birth-weight 19 lb. (It follows that the conception of an infant doubling or trebling the birth-weight at particular ages is apt to be misleading unless it is made clear that a baby of average birth-weight is referred to.)

During the second six months, the weight-gain is less (approximately $5\frac{1}{2}$ lb. or 2·5 kg.), and at a year of age a male infant is likely to weigh approximately $15\frac{1}{2}$ lb. (7 kg.) more than his birth-weight. (Exceptions to the general tendency for weight increment to be independent of birth-weight are of course found, *e.g.* first-borns, which are likely to make good some at least of their handicap during the first year of life.)

It has been shown (Parfit, 1951; Thomson, 1954) that weight increment in infancy is to some extent dependent on sex, and that when male and female infants are matched for birth-weight, the weight-gain of males is greater than that of females. At the end of the first year, therefore, differences in birth-weight are still likely to be reflected in differences in total weight, and males will on the average be heavier than females of similar birth-weight. During the second year when the infant is becoming increasingly mobile and active, the tempo of weight-gain slows down still further, and a total gain of approximately 5 lb. (2·3 kg.) over the twelve-month period is an expected average.

Length. As in the case of weight, increase in length during the first year is relatively rapid, but the speed is progressively decelerating and continues to do so during the second year. Thus the male infant gains approximately 8 cm. during the first three months, 6 cm. during the second three months, 9·5 cm. during the subsequent six months, and approximately 12 cm. during the whole of the second year. The corresponding increments for female infants are slightly less, but follow a similar pattern.

The head. At birth, six fontanelles are normally present, the large anterior and small occipital fontanelles lying in the midline and the small paired fontanelles (the sphenoidal and mastoid) lying in relation to the antero-inferior and postero-inferior angles of the parietal bone respectively. They represent sheets of membrane (persisting parts of the membranous skeleton). Of these the anterior fontanelle is of principal interest clinically, since its size, tension, and time of closure may be modified by disease. Thus increased intracranial pressure in infancy will be recognisable by bulging or tension of the fontanelle, and when acting over a long period will increase the size and shape of the bony aperture; rickets and cretinism will delay closure. Even in health, however, there is wide individual variation in the age at which the fontanelle is no longer clinically patent. Aisenson (1950) in a series of 1677 New York infants found that the age of closure varied from four to twenty-six months, and that the mean age of closure was 13·5 months. In infants included in the Oxford Child Health Survey, however, Acheson and Jefferson (1954) found that the mean age of clinical closure was slightly later, *viz.* 16·3 months (boys) and 18·8 months (girls). Mean age of radiological closure was 17·9 and 19·7 months respectively.

Circumference of the head increases extremely rapidly during infancy, the increase reflecting the general growth of nervous tissue shown in Fig. 20. The average circumference at birth of 13½ in. (34·6 cm.) increases by approximately 2 in. (5·1 cm.) during the first three months and by a further 1¼ in. (3·2 cm.) during the second three months; at twelve months the mean circumference is 18·3 in. (46·6 cm.) and during the second year a further increase of 1 in. (2·54 cm.) occurs. Measurements of girls are on the average slightly less than those of boys at all ages, the difference being ½ in. (1·2 cm.) from six months to two years of age (Meredith, 1946).

The Pre-school Period

From the age of two to five years, growth proceeds more slowly than during infancy with an average annual increment of approximately 4½ to 5 lb. (2 to 2·25 kg.) in weight and a slightly decelerating increase in height (approximately 3½ in. between two and three years of age, and 2½ in. between four and five years). The increase in height, however, is often sufficient to make the child appear to be 'getting thinner' and to cause parental concern unless it is pointed out that it is normal for the rounded contours of infancy to be gradually replaced by the more linear ones of childhood during this phase of development. Although the pre-school child is less vulnerable than the infant, he is exposed to a wider range of risks, particularly infections, and growth may readily be affected by adverse environmental conditions during this period.

With increasing age, the variation in individual growth becomes greater. The data of the Oxford Child Health Survey (Acheson *et al.*, 1955) for weights and heights during the pre-school period are given in Table 13 by courtesy of the

TABLE 13

Heights and Weights of Pre-school Children (Means and S.D.)

(Data of Oxford Child Health Survey, Acheson *et. al.* 1955, *Lancet*)

BOYS

Age Yrs.	Height in.	S.D. in.	Height cm.	S.D. cm.	Weight lb.	S.D. lb.	Weight kg.	S.D. kg.
2	33·95	1·39	86·2	3·5	27·76	3·23	12.59	1·47
2½	35·62	1·44	90·5	3·7	29·89	3·55	13·56	1·61
3	37·28	1·60	94·7	4·1	32·21	4·12	14·61	1·87
3½	38·84	1·69	98·7	4·3	34·69	4·67	15·74	2·12
4	40·16	1·74	102·0	4·4	36·75	4·99	16·67	2·26
4½	41·52	1·79	105·5	4·5	38·94	5·12	17·66	2·32
5	42·75	1·90	108·6	4·8	41·01	5·85	18·60	2·65

GIRLS

Age Yrs.	Height in.	S.D. in.	Height cm.	S.D. cm.	Weight lb.	S.D. lb.	Weight kg.	S.D. kg.
2	33·19	1·27	84·3	3·2	26·14	3·40	11·86	1·54
2½	35·08	1·45	89·1	3·7	28·62	3·55	12·98	1·61
3	36·71	1·45	93·2	3·7	31·02	4·13	14·07	1·87
3½	38·34	1·45	97·4	3·7	33·21	4·28	15·06	1·94
4	39·76	1·53	100·9	3·9	35·60	5·04	16·15	2·29
4½	41·04	1·60	104·2	4·1	37·68	5·24	17·09	2·38
5	42·38	1·72	107·6	4·4	39·78	5·71	18·04	2·59

authors. It will be seen that the standard deviations increase with increasing age and that at almost all ages the S.D. for height is slightly less for girls than boys.

Childhood, Puberty and Adolescence

During the early school period (five years to onset of puberty) the child shows a slight increase of annual weight increment (approximately 5 lb. from five to six years and 6 lb. from nine to ten years in both sexes), with an almost uniform height increment of 2 to 2¼ in. As indicated above, weight increases logarithmically with increase in height during this phase of development. The growth of lymphoid tissue at this time often results in the tonsils being regarded as abnormally large when they are in fact following their course of physiological development.

Boys are on the average heavier than girls of the same age throughout early childhood, although the skeletal development of the latter is more advanced. The erect height of boys is also slightly greater than that of girls up to the age of about eleven, but these differences in standing height are very small (in the order of 0·5 to 1 cm.) and may not appear consistently when recumbent length is measured, since this tends to eliminate differences of posture.

With the earlier age-onset of puberty in girls (the first signs of secondary sexual characters appearing at an average age of eleven and a half years compared with thirteen and a half years in boys), the spurt of growth which characterises early sexual development also occurs approximately two years earlier in girls. Since puberty occurs at widely different ages in different individuals, the pubertal spurt of growth is demonstrated much more clearly in longitudinal measurements of individual children, or of groups of children reaching the same stage of maturation, *e.g.* menarche at the same chronological age, that it is in cross-sectional data based on age alone. However, it is found that the average heights and weights of girls equal or exceed those of boys from approximately eleven and a half to thirteen and a half or fourteen years. The male spurt of growth then results in boys regaining their lead, and during the later teen-ages (when the growth of girls is decelerating rapidly or ceasing) the differences between the sexes becomes increasingly marked.

Table 14 gives cross-sectional data on stratified samples of Edinburgh schoolchildren from five to eighteen years of age. It should be noted that the weights represent naked weight and that allowance for this should be made in comparisons with other data, *e.g.* London schoolchildren where weights are measured in indoor clothing; and also that 'length' represents recumbent length and not erect height, which is slightly less than length (see p. 156). Comparison of the means of length and stem-length is shown in Fig. 29.

Where growth is measured in relation to sexual maturation rather than chronological age, it is found in girls that the maximum increment in stature occurs during the year preceding onset of menstruation (Simmons and Greulich, 1943), and that the menarche is followed by rapid deceleration and cessation of growth. Girls who reach the menarche early are on the average taller and heavier during childhood than those that mature late; their weight-for-height is also greater, and their pubertal spurt of growth is more rapid and of greater degree. Their growth, however, ceases earlier than those who mature late but grow more slowly over a longer period, so that the terminal height of girls with early menarche may be less

TABLE 14

Recumbent Length, Stem-length, and Naked Weight of Edinburgh Schoolchildren (Means and S.D.)

(From cross-sectional data of Provis and Ellis, 1955, *Arch. Dis. Childh.*)

BOYS

Central age (years)	Length cm.	S.D. cm.	Stem-length cm.	S.D. cm.	Weight kg.	S.D. kg.
5·5	109·3	4·9	62·5	3·0	19·0	2·1
6·5	115·4	6·2	64·9	3·0	21·0	2·8
7·6	122·1	5·8	67·5	2·9	23·8	2·6
8·5	125·2	5·1	68·5	2·7	25·2	2·8
9·5	130·5	5·9	70·8	2·6	27·5	3·3
10·5	136·0	6·0	72·8	2·5	30·3	3·8
11·6	141·3	6·7	75·3	3·4	33·4	5·1
12·6	148·1	7·9	77·8	3·7	37·0	5·6
13·5	152·5	8·5	79·9	4·1	42·0	7·8
14·5	159·4	9·1	83·3	4·6	46·0	7·8
15·4	167·2	8·7	87·7	5·0	54·6	8·9
16·6	173·5	8·3	91·6	4·7	60·6	8·4
17·5	173·7	6·9	92·4	3·6	62·5	9·7

GIRLS

Central age (years)	Length cm.	S.D. cm.	Stem-length cm.	S.D. cm.	Weight kg.	S.D. kg.
5·6	110·4	5·0	62·5	2·5	18·9	2·2
6·5	115·6	6·0	64·5	2·9	20·8	3·5
7·5	121·1	5·2	66·9	2·6	23·3	3·2
8·5	125·4	6·3	68·8	3·2	24·8	3·1
9·5	130·2	6·1	70·3	2·9	27·9	4·3
10·5	135·4	7·2	72·6	3·4	29·6	4·2
11·5	141·4	7·1	75·5	3·4	33·8	5·1
12·5	148·4	7·2	79·2	3·7	38·9	6·0
13·5	155·1	7·4	83·3	4·4	44·8	7·5
14·5	157·1	7·5	84·6	4·0	48·1	8·4
15·4	162·1	5·3	87·7	3·2	52·9	7·8
16·5	162·8	5·3	87·8	2·9	54·6	6·6
17·5	164·3	6·7	89·9	3·3	57·0	8·2

than that of girls who mature late (Stone and Barker, 1937; Shuttleworth, 1938). Similar observations have been made on boys (Ellis, 1946), those boys who mature early being on the average taller and heavier throughout childhood than those who mature late. Whilst acceleration of growth in height is likely to begin approximately at the onset of pubescence and to reach a maximum shortly before the point defined as onset of 'adolescence' in both sexes, gain in weight continues throughout the adolescent period. During this latter period also sexual dimorphism becomes more marked by increasing shoulder-width and muscularity in males; in females pubertal growth and remoulding of the pelvis is already well advanced before the menarche (Greulich and Thomas, 1944). The age at which growth in stature entirely ceases depends largely on the age at which sexual maturation occurs, but will on the average be one to two years later in males than females. Clements (1954) gave 17 years 9·08 months for boys and 16 years 2·71 months for girls as the mean ages at which growth in stature ceases. Other aspects of puberty and the endocrine control of growth during this period are discussed in the succeeding chapter.

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Chapter 7

PUBERTY AND ADOLESCENCE

The term puberty is used in the medical and legal literature to describe several slightly different phases of sexual maturation lying between childhood and adulthood, *e.g.* the point in time at which procreation becomes possible, or the period leading up to or following this point. For clarity in the present chapter, the term 'non-pubescent' is applied to children showing no evidence of secondary sexual characters or genital maturation; 'pubescent' to those in whom secondary sexual characters and early genital development are appearing; and 'adolescent' to girls who have reached the menarche (first menstruation) and to boys who have attained a stage of sexual maturation to be defined below, but are not yet fully adult. (This definition of adolescence is arbitrary, since the term is often used to cover the whole period between childhood and adulthood.) The transition from one phase of development to the next is not an abrupt one, since even the menarche (which is most readily determined in point of time) is not necessarily coincident with ovulation, and there is no fixed time-relationship between the appearance of the various indices of sexual development described. Although the physical and emotional changes which occur during the process of sexual maturation follow each other with a rapidity which is only comparable to the speed of development of the infant during the first two years of life, it should be clearly kept in mind that sexual maturation represents a transition period lasting three or more years, and involving physical and emotional problems peculiar to itself.

Clinical Manifestations of Sexual Maturation

This period is characterised by five closely interrelated features:

1. The pubertal spurt of growth (see Chapter 6), which commonly begins early in the process of maturation, reaches a maximum shortly before or after the 'adolescent' grading is attained, and subsequently decelerates rapidly until adult stature is reached with fusion of the epiphyses of the long bones. Rapid increase in weight often continues after deceleration in height-increment has begun, and the period of maximum weight-gain is not necessarily coincident with that of height.
2. The appearance of secondary sexual characters.
3. Rapid growth and development of the gonads and genitalia.
4. A general readjustment of endocrine balance resulting in the establishment of menstruation and ovulation in girls and of spermatogenesis in boys.
5. Emotional development and personality changes, which may be manifested by a variety of behaviour difficulties, frustration and self-consciousness before adult poise is attained.

Although some children are more fortunate than others in passing easily from the smooth waters of childhood to the troubled sea of adult life, the transition is often one of difficulty and embarrassment, and should always call for sympathetic handling. The rapidity of growth tends to make the adolescent awkward and ungainly; the boy may be dismayed by his large hands and feet, his acne and breaking voice, and the girl by transient obesity, or by her breast development and problems of menstruation. Both sexes usually experience a great increase of appetite coincident with their maximum growth; minor digestive disturbances, probably related to the rise in gastric acidity which occurs during puberty, and symptoms suggestive of mild hypoglycaemia are common. Vasovagal instability, manifested by blushing, tachycardia, or even fainting attacks, is very much more frequent at this time than during childhood.

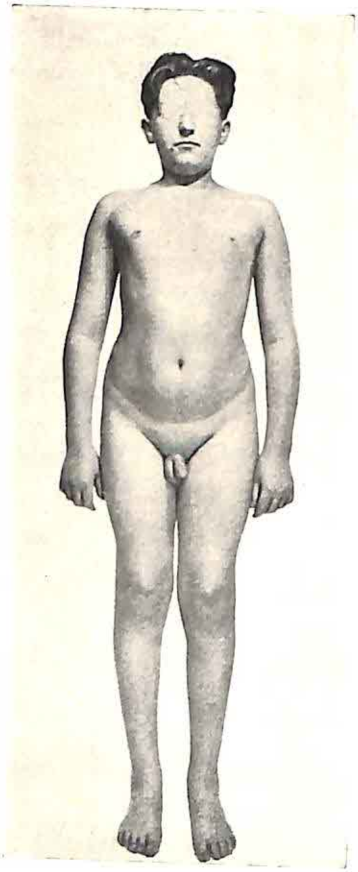

FIG. 35. Fat deposition of girdle-distribution giving a pseudo-feminine contour in a pubescent boy aged thirteen years.

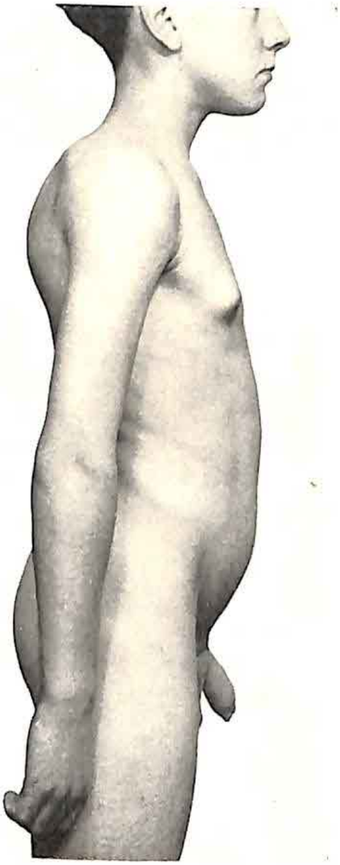

FIG. 36. Gynaecomastia in a pubescent boy aged thirteen and a half years.

Secondary sexual characters. Whilst there is no fixed order of appearance or development of secondary sexual characters, there is a general pattern for either sex to which most children conform. It is, for instance, very exceptional for axillary hair to appear before pubic hair, though this may occur. The speed with which one character follows another, however, varies greatly in different individuals, and although secondary sexual characters will ultimately accentuate the differences between the two sexes, transient characters of the opposite sex are often seen during pubescence. Thus, whilst breast-development is essentially a female character, a slight degree of gynaecomastia (Fig. 36) is very frequently seen in boys. Deposition of fat over the hips and shoulders may also give pubescent boys a pseudofeminine contour which is lost during later adolescence (Fig. 35).

Males. The earliest change, apart from accelerated growth which may precede it, is the appearance of non-pigmented 'vellus' or fine hair at the root of the penis. This is followed by the growth of occasional, darkly-pigmented, straight hairs in the pubic region, which are followed in turn by the more characteristic curled pubic hair, which appears first at the root of the penis and then forms a band across the pubic area immediately above. It is usually some months before the pubic hair spreads over the whole of the area characteristic of the female escutcheon and forms an inverted triangle; during this time extension also occurs downward on either side of the scrotum, and sparse, straight pigmented hairs commonly appear in the axillae. The next stage of development is marked by the appearance of finer dark hair on the inner aspect of the thighs, extension backward of the pubic hair to the anal region, and more profuse growth of axillary hair. The 'adolescent moustache' (short, sparse hairs at the outer margin of the upper lip, extending towards the midline) usually appears about this time, and may be associated with a slight growth of soft hair on the chin or cheeks. The eyebrows become heavier and tend to meet in the midline. The final distribution of male body-hair, *viz.* extension of pubic hair up the median raphe to the umbilicus; spread of finer hair over the lower abdomen, thighs, lower legs and outer aspects of the forearms; appearance of pigmented hair on the chest; and a strong growth of facial hair, is usually not achieved until late adolescence or early adult life, when marked differences are seen in the degree of hirsuties of normal individuals. The recession of the hair line over the temples is also a late manifestation of male maturity.

Gynaecomastia. The nipples normally enlarge slightly during pubescence, and the areolae become pigmented. In those boys in whom this stage of development is associated with transient fat deposition of feminine distribution, a considerable degree of subcutaneous fat may appear in the breast region and simulate breast development. Apart from this, however, a true gynaecomastia, or development of mammary tissue, attached to the nipple and palpable as a firm nodule, occurs in about 40 per cent of pubescent boys. It may be unilateral or bilateral. In some cases, particularly when there is no excess of subcutaneous fat around the nipple (Fig. 36), the breast-enlargement is closely similar to that first seen in pubescent girls. Whilst obvious pubescent gynaecomastia is likely to prove embarrassing and may cause some slight discomfort, it will commonly disappear spontaneously during later adolescence (usually within eighteen months of its appearance). However, if there is in addition evidence of protracted hypogonadism, nuclear sexing of buccal smears and examination of the sex chromosomes should be undertaken to exclude Klinefelter's syndrome.

Voice. The 'broken voice' is one of the most characteristic changes observed in the adolescent boy. The change in pitch is due to the rapid growth of the larynx and lengthening of the vocal cords which occur about the time of transition from pubescence to the later stage of maturity described as adolescence. During the short period of 'breaking', the pitch is variable and the true adult pitch associated with full growth of the Adam's apple may not be established until late adolescence. In addition to change in pitch, however, there is also a change in quality or timbre which distinguishes the voice (more particularly the vowel sounds) of both male and female adults from that of children. This is dependent on the enlargement of the resonating spaces above the larynx, due to the rapid growth of the mouth, nose and maxilla which occurs during adolescence. When the tongue is humped up during speech, two spaces are formed—one from the larynx to the 'hump' of the tongue, the other from this point to the teeth. In the child both are small, but in the adult if one is made small the other is automatically made larger. It is the sum of these resonating spaces which is responsible for the childish or adult quality of the voice.

FAT DEPOSITION. It has been mentioned that fat deposition of girdle or feminine distribution is not infrequently observed in pubescent boys. Since it is commonly transient, it is not itself a cause of concern. Unfortunately, however, it sometimes gives rise to a mistaken diagnosis of adiposogenital dystrophy when it precedes well-marked genital development, or when the deposition of fat over the pubis is sufficient to cause retraction of the penis. It is most undesirable to embark on hormone administration in such cases, since sexual maturation will occur normally without its aid.

SKIN. The sebaceous and apocrine sweat glands, particularly of the axillae and genital and anal regions, develop rapidly during puberty and give rise to a characteristic odour; the changes occur in both sexes but are more marked in the male. Enlargement of the pores at the root of the nose and the appearance of comedones and acne, whilst liable to occur in either sex, are considerably commoner in adolescent boys than girls, since the underlying skin changes are the result of androgenic activity. Thus in a series of boys aged eleven to sixteen years, comedones of the face were observed in approximately 20 per cent of those graded as non-pubescent, 41 per cent of those graded as pubescent, and 76 per cent of those graded as adolescent (Ellis, 1946). A roughening of the skin in certain areas (particularly over the outer aspects of the thighs and upper arms), associated with a mild degree of follicular keratosis, may be seen in both sexes during adolescence, but again is commoner in boys than girls.

Females. Vascularisation of the areolae and nipples is rapidly followed by the appearance of a palpable nodule of mammary tissue which, as it enlarges, results in visible prominence (the 'bud' stage). This is followed by an intermediate stage, in which breast and areola form a uniform elevation with little protraction of the nipple; this in turn by the 'primary mamma stage' (Reynolds and Wines, 1948) in which the areola and nipple form a definite secondary mound above the level of the breast; and finally the mature stage is reached in which the fully-developed nipple projects from the wide pigmented areola which has receded.

PUBIC AND AXILLARY HAIR. Pigmented pubic hair usually first appears on the labia majora, subsequently spreading upwards to the mons and ultimately covering the pubic area with an escutcheon having a horizontal upper margin. Axillary hair normally appears during the development of the pubic escutcheon, and on average slightly before the menarche. Although during pubescence the distribution of body hair may be closely similar in the two sexes the greater hirsuties of the male becomes increasingly obvious during later adolescence.

Genital Development

Males. The first unequivocal evidence of genital development may synchronise with the appearance of pigmented pubic hair, but may precede or follow the latter by a short interval. Both penis and testes show singularly little alteration throughout childhood; with the onset of pubescence the penis increases in both length and girth due to development of the corpus spongiosum and the corpora cavernosa, and the glans also enlarges in size. The body of the testis enlarges in relation to the epididymis and softens, the onset of testicular enlargement normally preceding penile growth. An increase in weight of the testes from 2 g. before eleven years to 17 g. at eighteen years occurs during sexual maturation (Stuart, 1946), and the body of the testis approximately trebles its length in the same time. The volume of the testis in ml., calculated by Lambert's (1951) formula $V = 0{\cdot}71 \times \text{length} \times \text{breadth}^2$, has been estimated as 5 ml. or less in the undeveloped state, increasing to a mean adult volume of 31·1 ml. during puberty (Rundle and Sylvester, 1962). The growth of the prepuce follows that of the glans. There is very commonly an increased production of smegma beneath it, necessitating scrupulous cleanliness. The scrotum becomes more pendulous and wider peripherally than proximally. There appears to be no fixed order in which these changes take place, and whilst the testes and penis commonly enlarge more or less at the same time, either the left or right testis may enlarge first, though the left testis is more commonly smaller than the right. Growth of the penis commonly follows the onset of testicular enlargement. The prostate, which has also remained small throughout childhood, enlarges rapidly during the later pubescent period, and becomes easily palpable on rectal examination. There are no reliable data as to when mature spermatogenesis occurs in relation to the clinical signs of sexual maturation. It may reasonably be assumed that spermatogenesis is not an 'all-or-none' process, but that the profuse production of mature spermatozoa is the end of a gradual process of maturation. It is also highly probable that there is considerable individual variation in the time-relationship of spermatogenesis to the appearance of secondary sexual characters such as pubic and axillary hair, but that in general it is characteristic of adolescence.

Females. Clinical evidence of genital development is shown by gradual enlargement of the labia majora and minora and the clitoris during pubescence, associated with fat deposition over the mons. Bartholin's glands become active. Rapid growth of the uterus occurs at the same time, though it does not assume adult proportions until later. The ovaries nearly double their weight between twelve and fifteen years. Simpkins (1932) described two types of follicle in childhood, the primordial, which lie in the primordial cortex and gradually degenerate until they finally disappear with onset of sexual maturity, and the primary, which are more or less constant from birth to sexual maturation, when their number increases. Three stages of development of these follicles with the approach of maturity have been described: (1) incomplete maturation, (2) complete or almost complete maturation without ovulation, which may be accompanied by anovular menstruation, and (3) full maturation with ovulation.

The onset of menstruation, which occurs on the average two years after the first evidence of breast development and a year later than the appearance of pubic hair, is in some cases preceded by one or more periods of abdominal discomfort without bleeding. Menstruation is often at first irregular with scanty or excessive flow and irregular intervals between the periods. Dysmenorrhoea is relatively common. It is sometimes many months before a regular cycle is established. Although the menarche will in some cases correspond with the first ovulation, it is not infrequent for a number of anovulatory cycles (which may in fact extend over one to three years) to follow the menarche. This is borne out by the observation that a period of 'adolescent sterility' (Montagu, 1946) commonly occurs amongst populations where marriage at or before the menarche is the general rule. It should be emphasised that although the onset of menstruation is often thought to be synonymous with capacity to procreate, this is not necessarily the case. The menarche is associated with changes in the vaginal mucosa, the cells not only altering from columnar to squamous form but also increasing in glycogen content.

Clinical Maturity Grading

Since sexual maturation is closely related to growth and physical performance (Espenschade, 1940; Ellis, 1948*b*; Jones, 1949), medical records should include some assessment of the stage of maturity reached at the time of examination. It is obviously undesirable to focus the attention of sexually-maturing children on this aspect of their development, and the more elaborate methods of maturity grading used in research studies (Shuttleworth, 1949; Greulich *et al.*, 1942; Schonfeldt, 1943; Stolz and Stolz, 1951; Rundle and Sylvester, 1962) and photoscopy (Fig. 37 and 38) will be inappropriate for routine medical examinations. The following grading is an attempt to provide a basis of assessment which is of clinical value, but requires a minimum of detailed examination.

Girls. Since breast-development normally precedes the appearance of pubic hair by at least some months, the former can be taken as the first evidence of sexual maturation, and record of the latter omitted without great loss of accuracy. Children who show no evidence of vascularisation of the nipple and areola or mammary development are classified as *non-pubescent*. Those in whom there is any degree of breast-development but who have not reached the menarche are graded as *pubescent*, and those in whom the menarche has already occurred as *adolescent*. (There is usually no difficulty in obtaining the information as to whether menstruation has or has not occurred and this can often usefully be supplemented by inquiry as to regularity or otherwise of the cycle.)

Boys. As medical examination of boys will normally include inspection to exclude undescended testis or hernia, a record of maturity can be made at the same time. Since there is no constant relationship between the appearance of pubic hair and early genital development (*i.e.* growth in size of penis and enlargement of the body of the testis in relation to the epididymis), the grading of *non-pubescent* is given to children in whom none of these signs have appeared, and *pubescent* when any one is already present. Although there will be a few borderline cases where there is difficulty in being certain of early genital development, the great majority can be graded on inspection alone. (In longitudinal studies such as that of Stolz and Stolz (1951) where a serial photographic technique was used, evidence of genital development will of course be recognised earlier than on isolated inspection.)

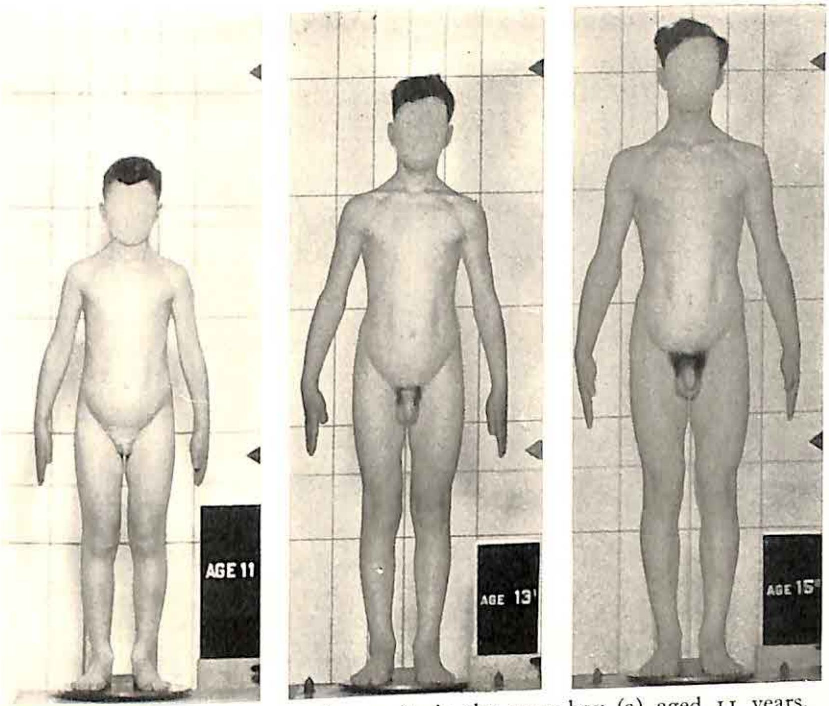

FIG. 37. Successive phases of maturity in the same boy (a) aged 11 years, non-pubescent, (b), aged 13 years, pubescent, (c) aged 15 years, adolescent.

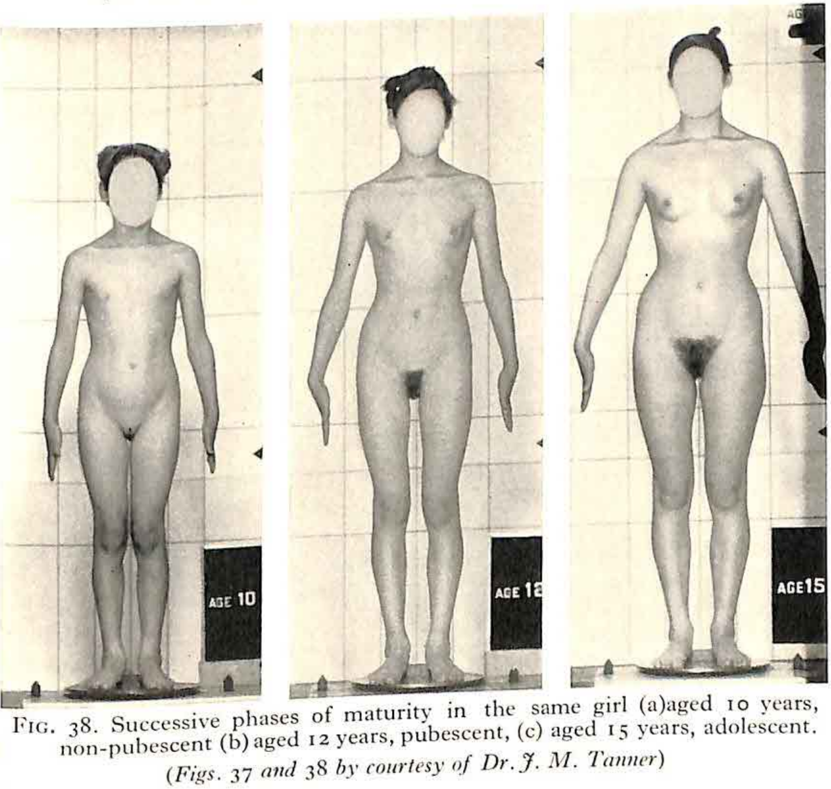

FIG. 38. Successive phases of maturity in the same girl (a)aged 10 years, non-pubescent (b) aged 12 years, pubescent, (c) aged 15 years, adolescent.

(*Figs.* 37 *and* 38 *by courtesy of Dr. J. M. Tanner*)

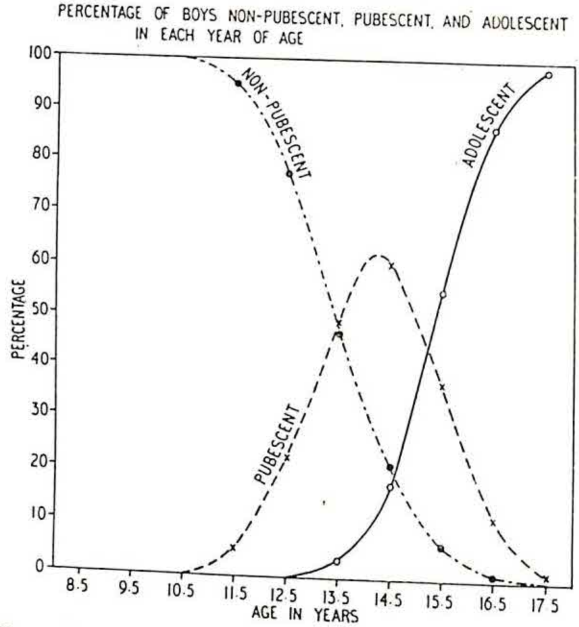

FIG. 39. (From Provis, H. S. and Ellis, R. W. B., 1955, *Arch. Dis. Childh.*).

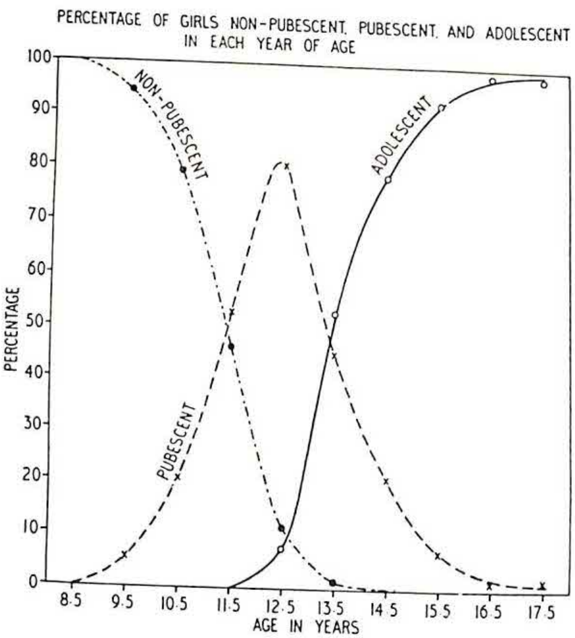

FIG. 40. (From Provis, H. S. and Ellis, R. W. B., 1955, *Arch. Dis. Childh.*).

Rather more difficulty arises in the *adolescent* grading. This is given when sexual maturation is well advanced, *i.e.* profuse pubic hair, plus axillary hair of whatever degree, plus well-marked genital development (substantial enlargement of both glans and girth of penis, plus testicular enlargement to not less than one inch in length with pendulous and rugose scrotum). If these several criteria are taken together, the number of doubtful gradings (which are unavoidable when there is gradual transition from one stage to the next) will be found to be relatively small. A less reliable criterion is to grade as adolescent those in whom the voice is regarded as 'broken'.

Figs 39 and 40 show the results of maturity grading applied to 1,730 Edinburgh schoolchildren. It will be seen, first, that the pattern is closely similar in the two sexes, but that girls on the average pass from one grading to the next approximately two years earlier than boys. Second, it is seen that the most heterogeneous ages, *i.e.* those at which all three gradings are substantially represented, are twelve and a half years in the case of girls and fourteen and a half years in the case of boys. By the time school-leaving age has been reached at fifteen years, the grading is much more homogeneous for girls, approximately 87 per cent being adolescent and none non-pubescent at this age. Thus the raising of the school-leaving age from fourteen to fifteen years has had the effect of throwing fewer non-pubescent children on to the labour market and has resulted in a greater proportion of children completing their period of pubescent development whilst at school. The social implications of this are considerable. From the point of view of the schools, the heterogeneous group of fourteen-year-old boys is probably the most difficult to deal with adequately owing to their varying physical and emotional development. On the other hand, there are obvious advantages in the majority of children having fulfilled at least a part of their pubertal spurt of growth before seeking employment.

Sexual Development and Endocrine Balance

The physical changes which have been described represent one aspect of a general readjustment of endocrine balance occurring between childhood and adult life. Whilst the anterior pituitary, the adrenal cortex, and the gonads are the triad of endocrine organs most directly concerned, others are affected to a greater or lesser extent, *e.g.* the thyroid. Thus the secretion of thyroxin, which is necessary for growth and skeletal maturation to be fulfilled, will be affected by any alterations in production of thyrotrophic hormone by the anterior pituitary, and temporary disturbances of thyroid function evidenced by thyroid enlargement and tachycardia are frequenly seen during adolescence, particularly in girls in association with the menstrual cycle. Many of the physical changes which occur during sexual maturation might be compared, in miniature, to those seen in one of the major endocrine disturbances. Thus the girdle distribution of fat which is sometimes seen in pubescent boys and girls may mimic that of Frohlich's syndrome; the rapid growth of the nose, mandible, and hands and feet is comparable to that of acromegaly; the hirsuties, acne and growth of the labia majora in girls represent a minor degree of virilism; and the thyroid disturbances described may simulate Graves' disease.

The exact mechanism by which the onset of sexual maturation is initiated at a particular time is still to some extent uncertain. It will depend both on the production of the necessary stimulus (here the gonadotrophic hormones of the anterior pituitary) and also on the capacity of the target gland (the gonads) to respond. The production of gonadotrophic hormones is probably dependent in turn on the necessary stimulus being received from the hypothalamus, but exactly why this stimulus is initiated or released at, say, eleven years of age in one child and at thirteen years in another, is largely conjectural. If we assume that it depends primarily on maturation of the central nervous system, we must also recognise that this maturation (or some other link in the chain) is under general genetic control (Crew, 1930) which can be further modified by adverse circumstances such as malnutrition or chronic disease of an essential organ.

The process of sexual maturation which has been described as the 'steroid' phase of development is characterised by the following changes in endocrine secretion, which are closely interrelated.

1. Increasing production of gonadotrophic hormones by the anterior pituitary. These include the follicle-stimulating hormone (FSH) and the luteinising hormone (LH); the latter is thought to be identical with the hormone stimulating the interstitial cells of the testis (ICSH). The production of a third gonadotrophin or luteotrophic hormone (LTH), maintaining the corpus luteum, causing the production of progesterone, and possibly acting on the adrenal cortex has also been postulated, but its production and excretion in human urine is not definitely proven.

In the female, FSH acts on the Graafian follicles, resulting in increase in weight of the ovary. LH (and possibly LTH) act on the corpus luteum, with the production of progesterone.

In the male, LH stimulates the Leydig cells of the testis to produce androgens, which are similar in structure and physiological action to androgens with other 17-ketosteroids produced by the adrenal cortex. (The 17-ketosteroids including androgen excreted in the urine of boys during late adolescence are probably one-third testicular and two-thirds adrenocortical in origin.) FSH stimulates the growth and development of the tubules of the testis, resulting ultimately in spermatogenesis.

2. The rapid growth and development of the gonads brought about by their response to gonadotrophic stimulation is followed primarily by testicular androgen-production in the male, and by oestrogen-production in the female. There is in addition a slight degree of oestrogen-production by the testis in the male, and possibly of androgen-production by the ovary. As, however, oestrogens are also produced from the adrenal cortex, it is probable that the adrenals are the principal source of oestrogens in boys.

The androgens in the male (both those produced by the Leydig cells of the testis and those originating from the adrenal cortex) result in growth of the penis, the appearance of sexual hair, the adolescent spurt of growth, and increased muscular development; they also finally cause fusion of the epiphyses and cessation of growth. The oestrogens produced in the male are responsible for gynaecomastia and other 'sex-inappropriate' signs.

In the female, oestrogens are responsible for the development of the vagina, uterus, nipples and breasts. They are thought to have an inhibitory effect on the pituitary growth hormone, and growth in the female ceases shortly after the rapid rise in oestrogen which is characteristic of mid-adolescence.

3. Adrenotrophic hormones produced by the pituitary (ACTH and possibly LTH also) stimulate the adrenal cortex to produce cortins and androgens in both sexes. The action of androgen in the male is described above. In the female, androgens are responsible for the appearance of sexual hair, growth of the labia majora and clitoris and such 'sex-inappropriate' signs as acne.

4. Production of pituitary growth hormone ceases in late adolescence when the epiphyses fuse, *i.e.* earlier in the female than in the male.

5. The urinary excretion of gonadotrophins is minimal during childhood and increases rapidly during pubescence. 17-ketosteroids are excreted in very small quantities by children of both sexes up till the age of eight or nine years, after which the urinary content rises steadily to adult levels, being greater in boys than girls. Oestrogen excretion is also minimal in both sexes during childhood; it rises rapidly in girls during pubescence and to a much smaller degree in boys. Ovulation in girls is followed by the excretion of pregnanediol.

Whilst the above is a necessarily over-simplified description of the hormones directly concerned with sexual maturation and does not include particulars of the menstrual cycle (see Brown, 1955; D'Amour, 1943; Pedersen-Bjergaard *et al.*, 1948; Kaiser, 1955), it will be seen that there is a highly complex interrelationship. Both boys and girls not only produce hormones responsible for 'maleness' or 'femaleness' respectively, but also, in lesser amount, hormones characteristic of the opposite sex. It is understandable that pubescence and adolescence are very frequently periods during which a certain imbalance is clinically recognisable. Thus although the earliest secondary sexual characters to appear in pubescence are normally sex-appropriate ones, *i.e.* breast-development in girls and pubic hirsuties in boys, these are frequently followed by sex-inappropriate characters before final stability of hormonal control is reached.

Factors Controlling the Age of Sexual Maturation

There is a wide physiological variation in age at which successive maturity-points are reached in different children, which may represent a difference of five years or more between very early and very late-maturing boys or girls. The maturation of girls has been shown (Figs. 39 and 40) to occur on the average two years earlier than that of boys. As in the case of growth and skeletal development, the age of sexual maturation is presumed to be under general genetic control, which may be modified by environmental factors. Unfortunately there are inherent difficulties in assessing the relative importance of different factors such as 'race', climate and nutrition in human material, and in most large-scale studies a number of variables have been introduced which limit any but the most general conclusions. Thus even the definition of 'race' in a manner satisfactory to a geneticist is often impossible, whilst different 'racial' or other groups may differ not only in their genetic constitution but also in dietetic habits and environment.

Genetic factors. From experiments carried out on mice, Crew (1930) concluded that the age of attainment of puberty was a genetic character, and that the experimental evidence suggested that precocity or early onset of puberty was dominant to retardation or late onset. Whilst the same may be true in humans, the evidence is less conclusive. There are, however, many recorded examples of familial sexual precocity occurring without gross endocrine abnormality, *e.g.* 27 affected males in four generations (Jacobsen and Macklin, 1952), which would certainly suggest a genetic origin; the pedigree recorded by Mortimer (1954) also shows sexual precocity occurring in males in four generations.

Climate. It is a popular belief that puberty occurs earlier in the tropics than in temperate climates, and this may be reflected in legislation, *e.g.* the legal age of consent or marriage. The weight of the existing evidence not only fails to support this view, but suggests that, amongst native populations in the tropics, puberty is no earlier, or actually later, than in Great Britain or America. A comparison of the age of menarche in two groups of Nigerian girls whose birth-dates were known, showed an average of 14·22 years and a median age of 14·40 respectively, compared with 13·73 and 13·6 years in Great Britain. A comparison of West African and British boys showed that the same maturity-points were reached at approximately the same ages in the two groups (Ellis, 1950). Wilson and Sutherland (1950) in Ceylon found that the average age of menarche of girls in rural surroundings was closely similar to that reported for Nigeria, though for urban girls the age was earlier. Although the West African studies were carried out on privileged groups whose diet and environment would be above average for the region, it must be recognised that the British and tropical groups were not comparable in other ways such as protein intake, or incidence of parasitic infection. It can only be said that such studies have in general failed to demonstrate earlier sexual maturation in tropical conditions which include a variety of factors other than climate alone. There is experimental evidence, however, that moist heat can retard the growth and development of laboratory animals (Ogle, 1934). The effect of extreme cold is more uncertain. Mills (1937) put forward the view that early development is stimulated by the 'climatic drive' of the central parts of North America and retarded by extreme cold or tropical moist heat, but the same objections apply to his figures when used for drawing conclusions from different groups living under differential environmental conditions, where climate is not the only variable factor. Most recent American studies have given earlier maturity-points than British studies of corresponding date, but it would certainly be unjustifiable to attribute this to climate alone.

Diet. By severely restricting the diet of rats, Asdell and Crowell (1935) showed that the first oestrus was delayed to the 375th day of life compared with the 55th in the case of normally fed controls. The conclusion that severe dietetic restriction can delay puberty was reached by different observers in several of the occupied countries of Europe during the war years, and it appears probable that deficiency of first class protein coupled with deficiency of total calories is most likely to do so. (Experimental work indicates that deprivation of vitamin E affects fertility rather than onset of puberty.)

Other factors. A large number of other factors, including season (Laroche, 1938), rural or urban environment, leisure, fatigue, emotional stimulation and the like, have been suggested as possibly influencing the onset of puberty. In most instances the evidence is too tenuous to allow conclusions to be drawn. There is no doubt, however, that chronic disease, either generalised or affecting an essential organ, may delay puberty to a degree which justifies the description of 'infantilism.' Examples of the former include congenital syphilis, leishmaniasis and chronic tuberculosis, and of the latter chronic renal disease and coelic disease.

Endocrine disorders. The major endocrine and neural disorders resulting in delayed or precocious puberty will not be considered in detail, and are only referred to in order to illustrate the various sites at which interference with normal development may occur. Retardation or failure in the establishment of puberty may result from:

Hypogonadism, due either to primary agenesis and chromosomal abnormality (*e.g.* Turner's syndrome in girls, Klinefelter's syndrome in boys) or to the effects of trauma, tumour, or infection. (Bilateral cryptorchidism will, if both testicles remain permanently in the abdomen, inhibit spermatogenesis, though not necessarily the appearance of secondary sexual characters; where there is no mechanical factor preventing descent into the scrotum, however, this will frequently occur spontaneously when the normal age of puberty is reached.)

Hypopituitarism. This may be congenital or secondary to tumour in the region of the anterior pituitary, or to acquired disease. Hypopituitarism is likely to be associated with marked retardation of growth; when obesity of girdle-distribution occurs in addition, the hypothalamus is usually involved. The diagnosis of 'Frohlich's syndrome,' or adiposogenital dystrophy, is often incorrectly made in boys whose growth is not retarded, and in whom obesity is due primarily to exogenous factors.

Hypothyroidism. Severe degrees of hypothyroidism (untreated cretinism and juvenile myxoedema) with result in generalised retardation of growth and development, including sexual maturation.

In addition to the above types, the term 'idiopathic infantilism' is applied to those cases, which may be familial, in which no primary lesion of an endocrine organ can be demonstrated. All the above disorders are relatively rare, and the great majority of cases in which delay in the onset of puberty has caused concern prove to be within the range of normality and not due to any pathological cause.

True precocious puberty is even rarer than infantilism of endocrine origin. It is typically associated with advanced skeletal development and growth, although cases in whom fusion of the epiphyses occurs prematurely will be smaller than their normal contemporaries when the latter reach adolescence. Possible causes of precocity include.

(1) Tumours of the testicle in boys or granulosa-cell cysts of the ovary in girls. (In most cases where the ovaries have been explored, however, the occurrence of small multiple granulosa-cell cysts suggests a secondary reaction). In both sexes, primary tumours of the gonads causing sexual precocity are rare.

(2) Hyperplasia or tumours of the adrenal cortex. These lesions will produce virilism in girls, *i.e.* masculinisation with hypertrophy of the clitoris and hirsuties rather than true precocious puberty, and in boys statural over-growth, appearance of secondary sexual characters, and growth of the penis without corresponding development of the testicles or spermatogenesis.

(3) Tumours of the pineal in boys and very rarely in girls, usually associated with some degree of hydrocephalus.

(4) A variety of lesions of the central nervous system, including tumours of the floor of the third ventricle and inflammatory lesions of the mid-brain or infundibulo-tuberal region. In some cases of 'idiopathic precocity,' where no gross

lesion has been demonstrated, it has been suggested that the stimulus to sexual maturation arises in the tuber cinereum (de Lange, 1943).

In children in whom no other abnormality is found, it is often difficult to define what should be regarded as 'precocity,' *i.e.* without the range of normality. As an arbitrary definition, sexual maturation beginning before the age of seven years in girls or nine years in boys should be regarded as pathological, though it will be realised that pathological causes may operate after these ages, and that there is the usual age-overlap between the extreme range of normality, and the abnormal. The hereditary or constitutional nature of some of the idiopathic examples of sexual precocity has been referred to above.

Normal Age of Sexual Maturation

Menarche. The great majority of studies of the age of sexual maturation have been carried out on girls, using the menarche as the most readily determined point. Except in long-term longitudinal studies, figures have either been based on cross-sectional data, *i.e.* determining the percentage of girls in each year of age who have reached the menarche, and calculating by probits or logits the median age at which 50 per cent of girls have menstruated and 50 per cent have not; or by obtaining by questionnaire from adults the age at which the menarche occurred and calculating the mean. (The latter method has the disadvantage of relying on memory of an event which may have occurred some years earlier.)

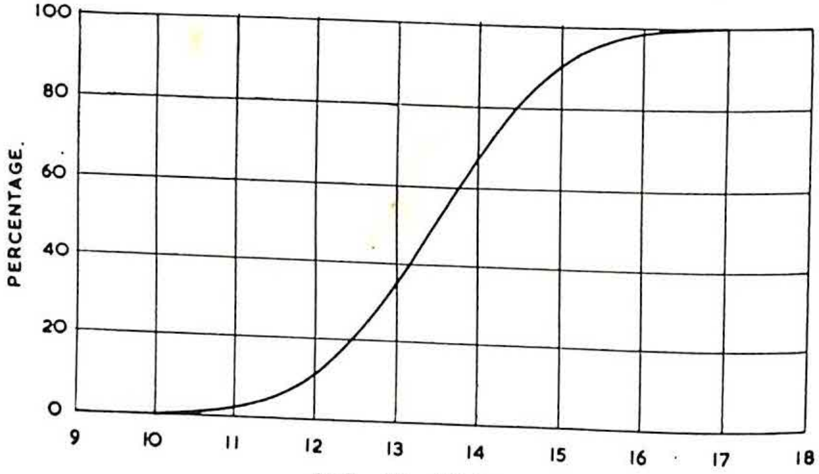

FIG. 41. Percentage of girls who at a given age have attained the menarche. Standard based on 2,590 girls. (From Wilson, D. C. and Sutherland, I., 1950, *Brit. Med. J.*).

An example of the former method is shown in Fig. 41 (Wilson and Sutherland, 1950). The median age in this series was 13·49 ± 1·19 years, and in the Edinburgh series (Fig. 40) 13·35 years. The second method is exemplified by the distribution curve shown in Fig. 42, based on a questionnaire of 470 British nurses. The mean age in this series was 13·73 years. Both methods serve to illustrate the wide physiological variation in different subjects. Thus Fig. 42 shows that whilst the mode of the curve lies between thirteen and fourteen years, and in 77 per cent of cases the menarche occurred between twelve and fifteen years of age, the spread is from approximately nine and a half years (three cases) to eighteen and a half years (two cases). Some North American series of normals have included cases in which menstruation has occurred in the ninth or even the eighth year, but since most American figures show that the average age of menarche is less than in Britain, the lower limit of normality is also likely to be less.

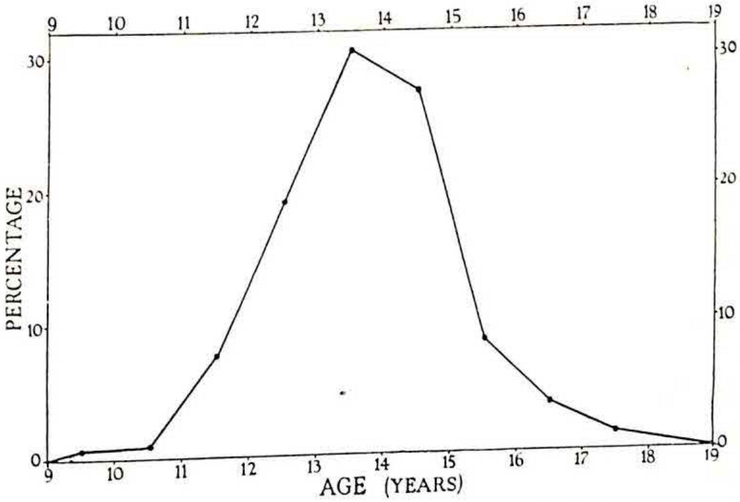

FIG. 42. Distribution curve showing percentage of subjects in whom onset of menstruation occurred in each year of age.

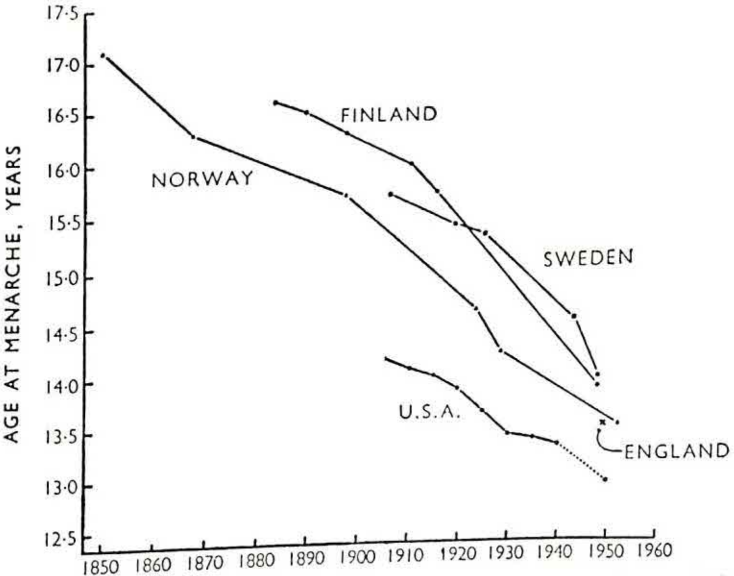

FIG. 43. Secular trend in age at menarche, from various data (Tanner, J. M. 1962 *loc cit.*).

SECULAR CHANGES. As in the case of growth, comparison of early and recent British studies strongly suggests that sexual maturation is occurring significantly earlier at the present time than fifty years ago. Thus Kennedy (1933), from data obtained from Edinburgh women, most of whom were schoolgirls at the beginning of the century, gave the average age of menarche as 15·04 years with a standard deviation of 1·70 years. This may be compared with the Edinburgh series of 1951–53, in which the median age was 13·35 years. Although the methods of ascertainment and sampling were not the same, the difference is so substantial that it provides strong confirmation of an acceleration of maturation as well as growth in the intervening years. Numerous studies in other countries have shown more clearly a secular trend towards earlier menarche, and Tanner (1962), from data available from 1850–1950, assesses this as approximately four to six months per decade.

Pre-menarcheal maturation. Female pubescence or the phase of development starting with clinical evidence of breast-development and ending with onset of menstruation, lasts on the average two to two and a half years. The age at which 50 per cent of girls were non-pubescent and 50 per cent showed evidence of breast-development was 11·30 years in the Edinburgh series, and Hogben *et al.* (1948) gave a closely similar estimate for English schoolgirls. North American data, however, have given a significantly younger age, *viz.* 10·6 years (Bryan and Greenberg, 1952). Pubic hair appears on the average nine to ten months after the first evidence of breast-development, and axillary hair shortly before the menarche.

Post-menarcheal maturation. The period which follows the menarche is often but not invariably characterised by irregularities of menstruation. Hogben *et al.* (1948) found that the proportion of girls with irregular periods diminished from the menarche onwards, and inferred that an appreciable proportion of girls passed through such a stage of irregularity. With the more reliable methods of hormonal estimation now available (Brown, 1955), it should be possible to determine the time-relationship between menarche and ovulation in individual children, and to assess first, the average interval between the two maturity-points, and second, whether this period corresponds with the phase of atypical menstruation preceding the establishment of a regular cycle.

Male pubescence. The median age of onset in the Edinburgh series of day-school pupils was 13·45 years, and 13·4 years in a previous study of boys in two English residential schools (Ellis, 1948). Bryan and Greenberg (1952), using the same criteria in their North American study, gave 13·1 years as the median age, but other American data (*e.g.* Stolz and Stolz, 1951) suggest that the average age-onset of pubescence may fall during the thirteenth year. The distribution curve for the Edinburgh series is shown in Fig. 39.

The duration of pubescence for boys maturing at the average age appears to be in the order of eighteen months to two years when the criteria of 'adolescent' grading given above are used.

Male adolescence. The age at which 50 per cent of boys were graded as 'adolescent' and 50 per cent less mature was 15·35 years in the Edinburgh series. It will be seen from Figs. 39 and 40 that the curves for male and female adolescence (the latter being based on menarche) are generally similar in shape, but that the male maturity-points are approximately two years later than the corresponding female ones.

It is probable that the male 'adolescent' grading represents a slightly earlier phase of development than that of mature spermatogenesis, for which Stuart (1946) gave an average of fifteen to sixteen years, this estimate being based on North American data. (A distinction should, of course, be drawn between the production of mature spermatozoa and the production of prostatic secretion with or without immature spermatozoa which will precede it.) The occurrence of spontaneous nocturnal emissions is suggestive of the stage of mature spermatogenesis having been reached, but is so much influenced by extrinsic factors that it is unreliable as a maturity-point.

Care of the Adolescent

The structure of modern society provides greater problems for adolescents than for members of any other age group, and despite the increasing attention given to adolescence by teachers and employers, many of these problems remain largely unsolved. In a primitive community, the undertaking of adult work and responsibilities including marriage, together with the attendant adult privileges and outlets, is likely to be governed primarily by physical development and capacity. In civilised society, the long period of apprenticeship necessary for most types of adult occupation and remuneration, the taboos on sexual outlet, and the overriding emphasis on chronological age rather than on development and maturation, give many adolescents a sense of frustration which is liable to lead to defiance of authority and conflict with society unless their energies and interests can be directed into channels which are socially desirable.

Since pubescence and adolescence are essentially periods of sexual maturation, parents and other adults must honestly face the fact that sexual interests during this transition period are bound to be active and may even be as urgent as at any period of the life span. Although a more realistic attitude to sex is nowadays common, many adults (usually as a direct result of their own early upbringing) still adopt a shamed or repressive attitude to any sexual interest shown by the infant or child, and have already transferred a sense of guilt and subterfuge before adolescence is reached. In such cases it is clearly difficult or impossible for the adolescent to ask adult advice when this is most needed, even supposing that the adults available are competent to give it objectively. It should clearly be borne in mind that the aim of physical and emotional fulfilment in adult life is a satisfactory marriage relationship, and that adolescence is the period during which the young individual is developing toward that end. In the school environment which is primarily concerned with academic education or training, the adolescent often receives far less guidance in the field of human relationships than his or her apprenticeship for adulthood requires.

It should also be realised that sexual impulse in the adolescent frequently takes some time to be clearly canalised towards the opposite sex. During pubescence, the child is likely to have an increasing interest in his or her own body, aroused not only by the endocrine changes which are taking place but by the appearance of secondary sexual changes and genital development. In some cases this is followed by a transient attraction to members of the same sex. This may be regarded more calmly if it is remembered that both boys and girls are producing hormones typical of the opposite sex, and that as adolescence progresses, androgens will become dominant in the male and oestrogens in the female. Admittedly a small proportion of both sexes become emotionally arrested at this stage of development, but this does not affect the fact that the great majority of those who pass through it, reach the adult heterosexual phase which normally follows.

The adult attitude to masturbation, which according to Kinsey, has been practised by over 90 per cent of boys by the age of seventeen must be carefully adjusted to the individual concerned. It is now generally recognised that the only physical effect that the practice is likely to have is that of temporary fatigue, but that if it is accompanied by a profound sense of guilt, this latter may be emotionally damaging. If an individual child is already suffering from a sense of guilt, only harm can be achieved by adding to it. The attitude here might well be that masturbation is an experience which has been shared by almost all adolescent boys and adults, who have subsequently grown out of it, and that no permanent harm has been done. For those where it carries little or no guilt-feeling or anxiety, but in whom there is the natural desire to grow up, it may be put in the light of a mark of immaturity, a phase which is left behind when adult behaviour is established. In the exceptional case where obsessional masturbation is accompanied by other evidence of profound emotional upset, masturbation should be regarded as a symptom rather than a disease, and the underlying disturbance investigated.

The hygiene of adolescence should be established or taught before puberty if the child is to grow into a self-respecting adult. The development of the apocrine sweat glands and the onset of menstruation make regular bathing during adolescence even more necessary than during childhood, but the principles of body-cleanliness should have been learnt much earlier and only require re-emphasis at this time. (Similarly sex-education should not represent an emotional high-dive to be taken for the first time at puberty, but simply as an amplification of existing knowledge of body-function and structure built up gradually from early childhood.) Girls should be forewarned of the onset of menstruation, and taught the use and disposal of sanitary towels. Whilst school authorities normally provide suitable facilities for adolescent girls in secondary schools, it is not always realised that, with the earlier onset of menstruation, there are liable to be some children in primary schools for whom such facilities are equally necessary. A recent study (Ward, 1964) showed that 15 per cent of girls were menstruating by the age of 12, *i.e.* the time at which transfer from primary school is normally made in Scotland. The advisability of girls taking part in organised games during menstruation must be decided for each individual. If physical exercise at this time can be carried out without discomfort or excessive fatigue, there is no contra-indication to it or necessity to regard menstruation as a period of invalidism. However, many girls do in fact suffer considerable disturbance at least during the first months or years after the menarche, and in these cases their régime should be modified accordingly. It should be emphasised to them that these disabilities will probably cease as the adult cycle is fully established.

In both sexes, it should be remembered that the pubertal spurt of growth (roughly coincident in onset with the appearance of secondary sexual characters and reaching its maximum approximately two years later) makes considerable demands on the stamina of the individual, and that whilst physical performance will in general increase with increasing maturity, excessive demands on endurance should not be made during the period of most rapid growth. R. W. B. ELLIS

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Chapter 8

BEHAVIOUR DEVELOPMENT

THE study of behaviour development is the study of the series of changes by which a helpless, newborn infant becomes an independent adult. The questions which investigators have tried to answer concern, for the most part, the order in which these changes occur, the average ages at which they may be expected to begin or to reach completion and the circumstances which appear to favour or to retard their appearance.

Although there are some very general patterns of development to which all children conform, there are, within the limits of normality, wide variations in the order in which specific pieces of behaviour appear and in the rate at which they succeed one another. In the same way as rates of physical growth may be slower or more rapid than average in different children, so the 'milestones' of behaviour development may be achieved earlier or later than the average. Some healthy children may say their first words by the age of ten months yet be unable to walk without support until the age of sixteen or seventeen months, whereas others quite as healthy may walk unsupported by the age of twelve months but fail to say intelligible words until they are aged two years or more.

The varying patterns of behaviour development are the outcome of a complex set of circumstances. At any given moment, when a child produces, or fails to produce, a new piece of behaviour, he is responding to his immediate environment, but in so doing he is bringing into play developed qualities of personality and intellect, as well as physical skill. They, in their turn, are the outcome of his genetic constitution, the circumstances of his intra-uterine life and his previous experiences in the environment. These last may have been experiences of the kind which encourage learning and stimulate growth, but they may equally have been experiences which damage, limit or deprive. For example, meningitis in early infancy may lead to a hearing impairment and thus to speech development which is retarded and abnormal.

The assessment of behavioural maturity consists of comparing the various achievements of the child under study with those of a representative group of children from the same community. To facilitate this comparison, Gesell (1940) made separate assessments of motor, linguistic, adaptive and social behaviour. These categories though arbitrary and to some extent overlapping, have been found useful in clinical practice. 'Developmental diagnosis' consists of comparing the motor, linguistic, adaptive and social performance of the individual with the 'norms' of performance for different ages. For example, a child of eighteen months who was unable to sit without support or reach for objects, but whose linguistic, adaptive and social performance was otherwise normal, would be considered to show specific retardation of motor development. If the retardation of his motor development was severe enough he might show the persistence of reflexes characteristic of the neonatal period which should have disappeared in earlier infancy such as the Moro reflex, the asymmetrical neck reflex, or the stepping reflex. Causes of his specific motor handicap might be congenital malformations or birth damage of the brain. Another example would be a child who was found to be retarded in language development without commensurate backwardness in reaching motor, adaptive and social 'milestones'. In this case deafness would be one of many possible causes to be considered.

It is possible by using the techniques of developmental diagnosis to suspect mental retardation in many children who are still too young for formal tests of intelligence. Most children who suffer from severe mental subnormality show global retardation of behaviour development though the retardation of motor development is usually less marked than that of linguistic, adaptive and social behaviour and in some motor development may be normal. The diagnosis of lesser degrees of mental subnormality must always be made with the greatest of caution and may not be possible until the child is three years of age or more, at which time standardised formal tests of intelligence can be employed. As children grow older assessment of behaviour development becomes, in many ways, easier and long range prediction of future development can be achieved with increasing accuracy.

The study of sequences of development has given rise to the notion that the timing of a given event may importantly affect its influence on subsequent behaviour. It is possible for experiences to come too early or too late to be effective. For instance, there is evidence that practice before the child is 'ready' to learn a new motor skill is much less valuable than a comparable amount of practice once the point of readiness has been reached (Gesell and Thompson, 1929; Hilgard, 1933). Similar findings have been obtained in respect of early language development. Strayer (1930), working with identical twins aged one year eight months, found that an age difference of five weeks made an appreciable difference to the effectiveness of attempts to increase the children's vocabulary.

On the other hand, there is evidence that, in respect of certain forms of behaviour, opportunities may come too late. For example, children who have been blind from birth because of congenital cataract and are given vision only at the age of four or five years may never be able to distinguish simple geometrical figures or to recognise human faces as well as the normally sighted. Yet there is evidence that normal infants have some capacity for pattern discrimination even by the age of one week when there has clearly been little or no opportunity for learning (Fantz, 1961). It now seems likely that there exist certain classes of behaviour which need no learning or very little learning at the time when they normally appear but which, if abnormal circumstances prevent them from being exercised at that time, become increasingly unlikely to occur—or difficult to learn—as development progresses. Knowledge of the points at which most is likely to be gained or lost through the presence or absence of certain conditions is plainly of the greatest practical importance.

The Newborn

In the first weeks after birth the child's activities are chiefly concerned with feeding, excretion and respiration and with adjusting these functions to the conditions of extrauterine existence. The baby makes reflex responses to auditory, visual, gustatory and tactile stimuli, but deliberate, purposeful responses are lacking. The behaviour of babies suffering from anencephaly (congenital absence of the cerebral hemispheres) who survive may be remarkably normal for the first four to six weeks of life.

The newborn baby is largely at the mercy of his environment and any change which makes him uncomfortable, particularly hunger, or excessive heat or cold, will make him cry. When he is comfortable he tends to sleep. The newborn baby is completely dependent upon his parents for food, care and protection.

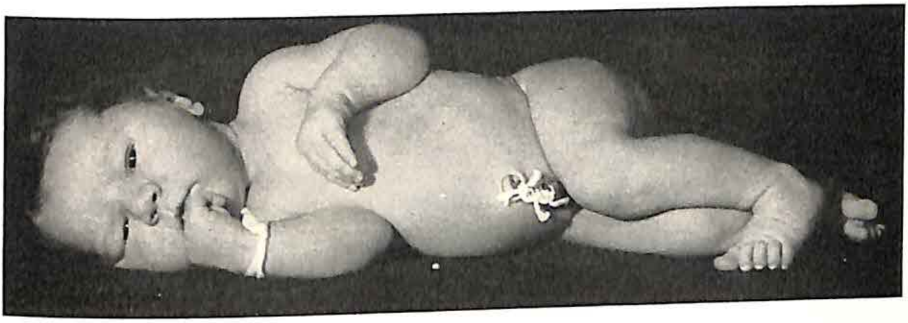


FIG. 44. The characteristic posture of the newborn baby is one of semiflexion of the neck, trunk and limbs. The hands are usually closed and the thumbs grasped in the palms. The posture is very similar to that of the foetus in the womb.

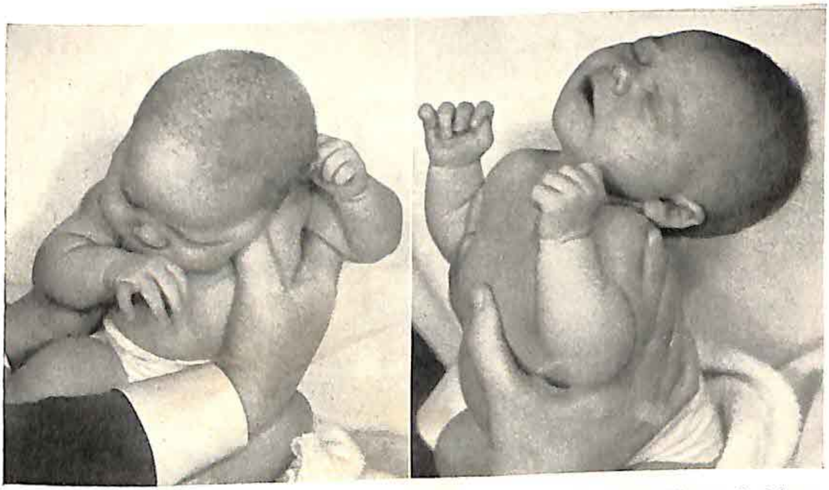


FIG. 45. Newborn infant aged twenty-four hours, showing inability to hold up head in erect position.

Motor activities of the newborn. The resting posture of the mature newborn is usually one of semiflexion of the trunk and limbs, a modification of the foetal position of generalised flexion, though babies born by the breech with extended knees may keep the lower limbs in this position for some weeks after delivery. Because of their semiflexed posture newborn babies tend to lie mostly on their sides when at rest or sleeping (Fig. 44).

The newborn baby has very little control of posture. When placed in the supine position his head falls back into a hyper-extended position but he should be able to maintain the semi-extended position of his head when held prone (Fig. 45). In contrast to the rather free movement of the head which occurs with changing positions, the postures of the upper limbs remain relatively constant.

In most babies the tonus of the flexor muscle groups is greater than that of the antigravity muscle groups for the first six to eight weeks of life. Muscle tone varies greatly in different babies and from time to time in the individual child. Tone is increased when the baby is hungry or crying and relatively diminished when he is satisfied and comfortable.

Spontaneous movements appear to be curiously random and purposeless in the newborn, and the limbs tend to move all in one piece from the proximal joints without co-ordinated movements in the distal parts. Movements of the upper limbs commonly result in the hands being placed to the mouth. Sucking of the thumb and scratching of the face may occur within a few hours of birth. When the lower limbs are moved spontaneously, reciprocal pedalling or 'bicycling' activity is often found. Mass movements affecting the trunk and all four limbs as in yawning or stretching are characteristic in the newborn period. Many of these involuntary, subcortically controlled movement patterns are strikingly similar to those exhibited by lower forms of animal life and by decerebrate mammals. Swimming and crawling movements which resemble those found in amphibian and reptilian swimming and crawling may be demonstrated in the newborn. They become progressively inhibited by higher nervous centres after the first two or three weeks of postnatal life, but may persist in patients with severe developmental abnormalities or birth damage of the brain (McGraw, 1943).

Reflexes in the newborn. A number of well-defined reflexes should be present in the newborn child and their absence usually indicates abnormality of the nervous system or serious systemic disease. It is important to remember, however, that the ease with which particular reflexes may be elicited depends greatly upon the physiological state of the infant. For example, the feeding reflexes are greatly enhanced by hunger and depressed if the baby is satisfied, while the Moro reflex may be difficult to elicit in some babies if they are too drowsy and in others if they are crying.

A number of feeding reflexes have been described in the newborn. They are all subcortically mediated and are the most constantly present of the infantile reflexes. The rooting or search reflex is the name given to the reflex orientation of the head towards a touch stimulus in the perioral region. Two patterns of response have been described by Prechtl (1958). In the first there is a repetitive side to side movement of the head away from and towards the stimulus, the range of oscillation of the head gradually diminishing until the stimulus is approximated to the mouth. This response is characteristically found in premature babies but is present in a proportion of maturely born babies for a week or two after birth. The second response, which supersedes side to side head turning, is often present from birth in mature babies, and is called the 'directed head turning reflex'. This consists of a single, well-directed, purposeful-looking movement of the head which results in the infant's mouth being placed in contact with the touch stimulus.

What is often termed 'the sucking reflex' really comprises two reflexes: the lip reflex, lip phenomenon or 'l'épreuve des points cardinaux' (André-Thomas *et al.*, 1960) and the sucking reflex proper. The lip reflex may most easily be elicited by a gentle stroking stimulus in the perioral region moving towards the mouth. The response consists of mouth opening and a movement of the parted lips towards the stimulus so that the mouth is often opened towards one side rather than in the mid-line. As the mouth opens, the tongue usually protrudes at least as far forwards as the lips and is curved so as to be concave superiorly, forming a trough in which the nipple or teat stimulus is taken into the mouth. As the tongue and nipple are pulled into the mouth, the infant closes the lips and often swallows (Fig. 46).

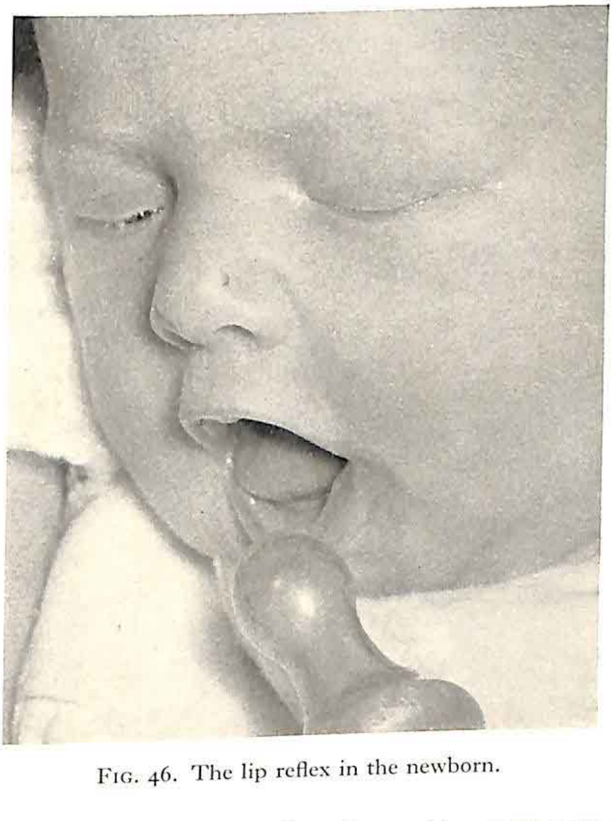


FIG. 46. The lip reflex in the newborn.

The actual sucking reflex consists of a reflex sucking movement elicited by a touch stimulus applied to the infant's lips, the front of his tongue, his gums or hard palate.

The swallowing reflex is the name given to the swallowing movement which occurs when fluid or food is placed in contact with the walls or the back of the pharynx, on the back of the tongue, the epiglottis or the soft palate. In practice, the easiest way to elicit the swallowing reflex is to cause the infant to suck, for sucking will draw saliva towards the back of the mouth and usually this in turn produces swallowing.

In successful feeding the rooting, lip, sucking and swallowing reflexes are integrated closely one with the other. The movements of head rotation towards the nipple, mouth opening, tongue protrusion and retraction with mouth closure, sucking and swallowing occur so rapidly and smoothly that where one reflex ends and the next begins is difficult to determine. The feeding reflexes become less easily elicited in most babies after the age of five or six months but the time at which they actually disappear is extremely variable. They may be elicited in many drowsy children of three or four years of age.

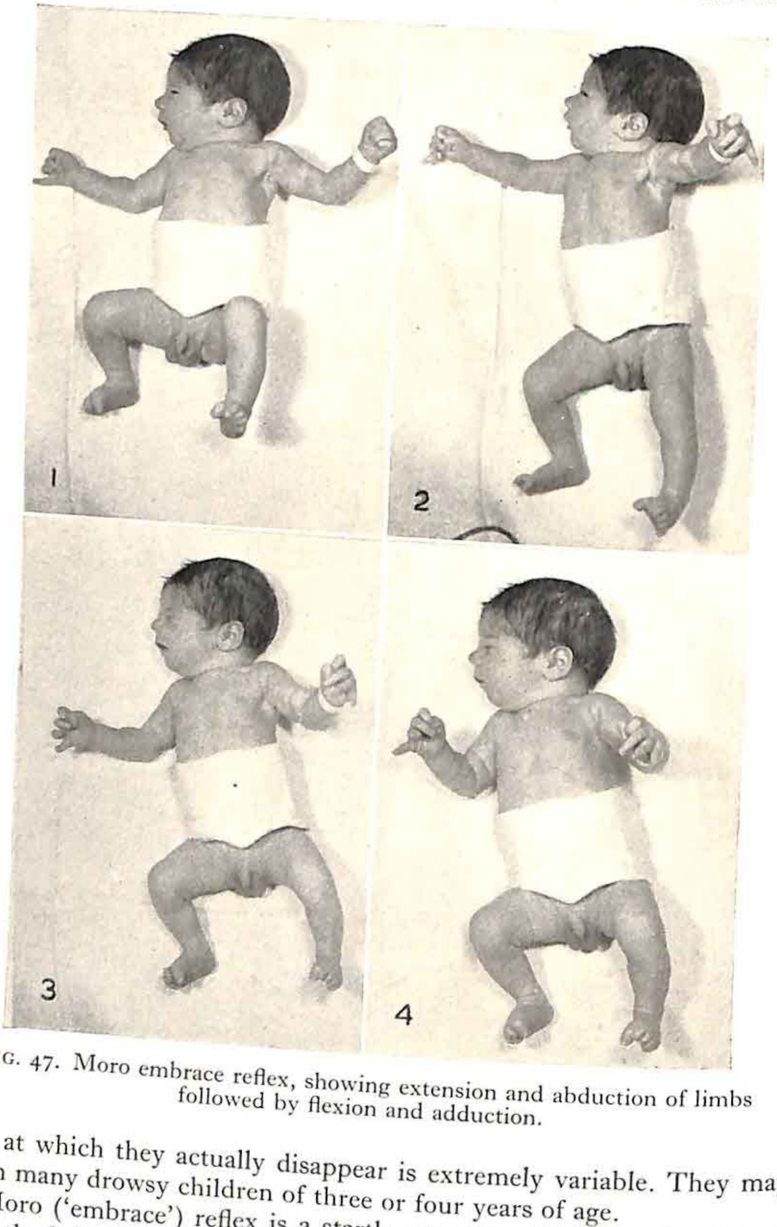


FIG. 47. Moro embrace reflex, showing extension and abduction of limbs followed by flexion and adduction.

The Moro ('embrace') reflex is a startle response which may be elicited by changing the baby's position abruptly, tapping his clavicles, knocking the sides of his cot or often by subjecting him to a sudden loud noise. After a momentary flexion movement of the head, trunk and limbs, so rapid that it can only be observed cinematographically, there is a rather abrupt extension of the spine and extension and abduction of the arms and legs. These movements are succeeded by slower flexion and adduction of the limbs and relaxation of the spinal muscles (Fig. 47). The reflex is very constantly present in healthy mature and premature babies. It is most easily elicited in the first four to six weeks of life but is usually present in infants under the age of three months. It is usually absent by the time the child can sit even momentarily without support.

Grasp reflexes (Fig. 48) are evident in the hands and feet of normal neonates, and in the hands they may be so powerful that the infant can be lifted grasping a rod or the examiner's fingers. Grasp reflexes are usually more marked and are easier to elicit in premature infants than in those born at term. The time of their disappearance is variable in the normal infant but they become less easy to elicit after the age of four or five months.

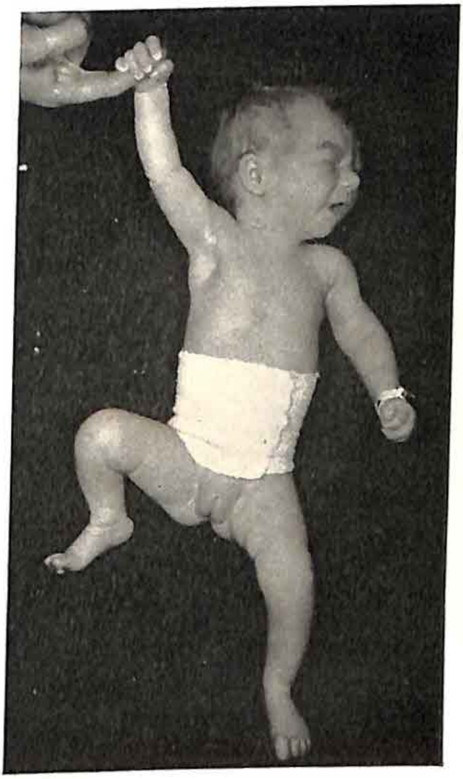
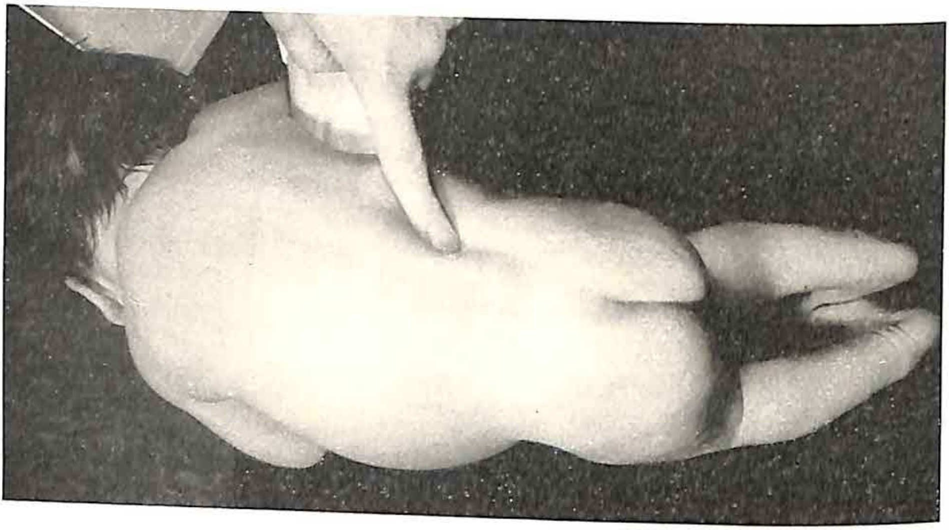


FIG. 48. The grasp reflexes are present at birth in both the hands and feet. The most reliable stimulus is a touch of moderate pressure moving distally in the palm of the hand.

Galant's reflex, or the trunk incurvation response, is elicited by exerting pressure medially beside the spine between the lower ribs and the pelvis. The response consists of a reflex incurvation of the trunk which results in the spine being made concave on the side of the stimulus (Fig. 49). This reflex can nearly always be elicited in the newborn and it commonly persists until the baby is two or three months old.



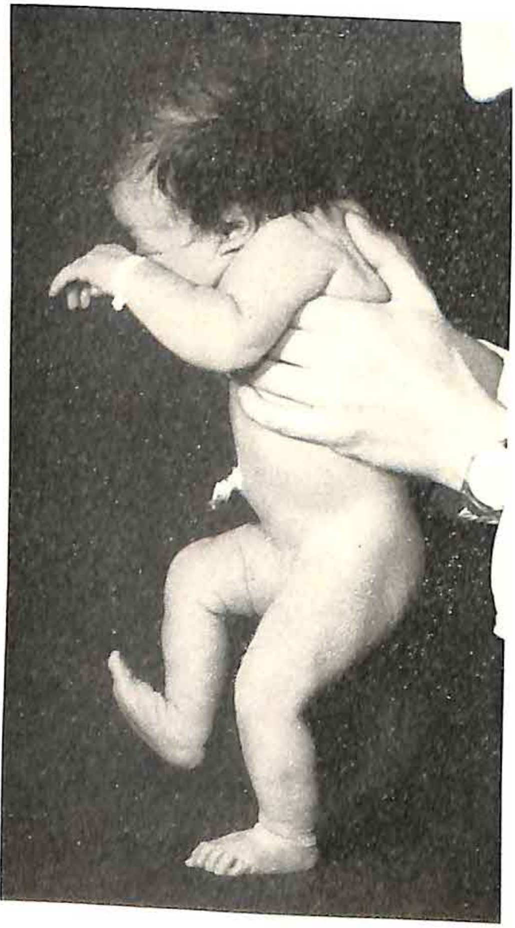


FIG. 49. (above) The Trunk Incurvation Response. Firm pressure in the newborn loin makes the baby curve his trunk concavely on the side of the stimulus.

FIG. 50. Reflex stepping in the newborn.

Reflex stepping is elicited by placing the baby in a walking position and tilting him forward and alternately to one side and the other. So long as he is supported, the infant then progresses along any flat surface, whether it is vertical or horizontal, with a regular reciprocal high stepping movement of the lower limbs without further artificial propulsion being necessary (Fig. 50). Reflex stepping is most easily elicited in the third or fourth week of life and, thereafter, gradually becomes more difficult to demonstrate (Peiper, 1963).

Tendon reflexes which are found in the adult are normally present in the newborn infant. Owing to the marked variations in muscle tone which occur, depending on whether the infant is restless or at rest, hungry or satisfied, the jerks may be brisk, or sluggish and are often difficult to elicit.

The plantar responses are usually extensor in the newborn infant and remain so until about the time he crawls or begins to stand, when they become flexor. In a proportion of normal neonates, however, the plantar responses are flexor and a large number of variations in the form of the neonatal extensor responses have been described (Brain and Wilkinson, 1959).

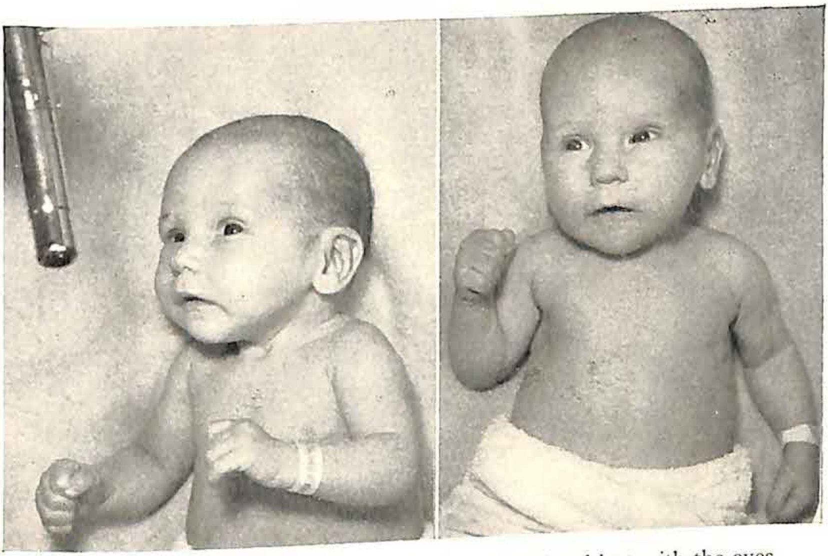


FIG. 51. Infant aged four weeks following a bright object with the eyes.

Abdominal reflexes of the adult type are present in only a minority of normal newborn children. In the majority, superficial stimulation of the abdomen results in a diffuse contraction of the abdominal muscles and writhing movements which may involve the trunk and limbs. Localised abdominal reflexes of the adult type commonly appear between the ages of three and six months (Harlem and Lönnum, 1957).

The healthy, mature, newborn infant reacts to strong light by reflex constriction of the pupils and firm closure of the eyes. Transient focusing of the eyes on a light source has been described in the first few days after birth and Gesell reports monocular fixation of nearby objects in the first week, but consistent fixation on objects and attempts to follow their movements with the eyes are found only towards the end of the first month of life. Reflex accommodation of the pupils as the eyes converge to fix on a near object is not usually evident before the age of about ten weeks.

Reflexes of posture and equilibrium which occur in the newborn have been studied by Magnus, André-Thomas, Peiper and others. It has been shown that voluntary control of posture, first shown by the infant's ability to maintain the position of the head steadily, is the result of the cortical control and integration of a number of subcortical postural reflexes. These result from stimuli received from the retinae, the otolith organs of the labyrinths and proprioceptive nerve-endings in joints and muscles, especially those in the region of the head and neck.

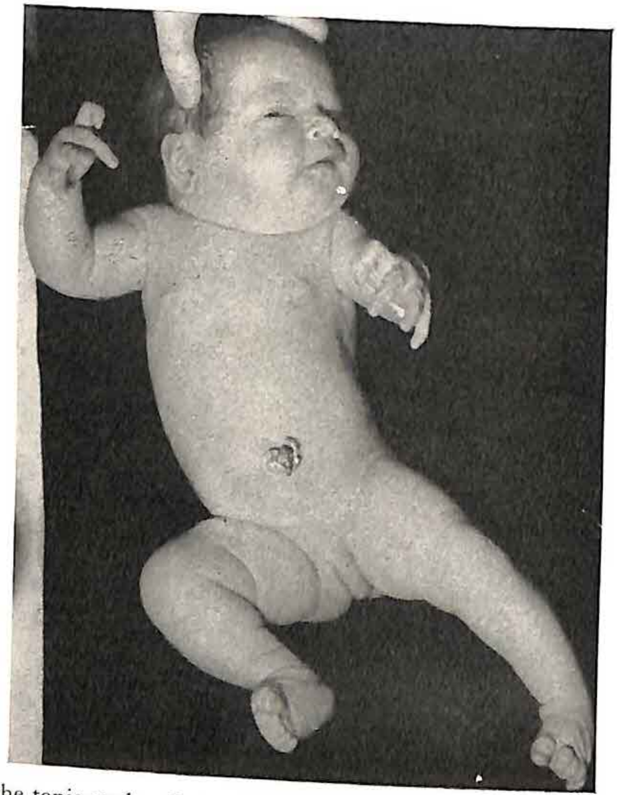


FIG. 52. The tonic neck reflex consists of an extension of the limbs on the side towards which the head is turned, and flexion of the contra-lateral limbs.

Initially, adjustments of the child to postural changes appear to be due chiefly to the effects of proprioceptive stimuli. The tonic neck reflexes (Fig. 52) are almost invariably present very shortly after birth. The asymmetrical tonic neck reflexes are most easily elicited by passively rotating the head of the supine infant to the side. This results in reflex extension of the limbs on the side to which the head is turned and flexion of the contralateral limbs (the 'fencing position'). Marked passive flexion of the head while the infant is held supported by a hand under the abdomen results in increased flexion of the limbs, and less constantly passive extension of the head causes extension of the limbs. The tonic neck and

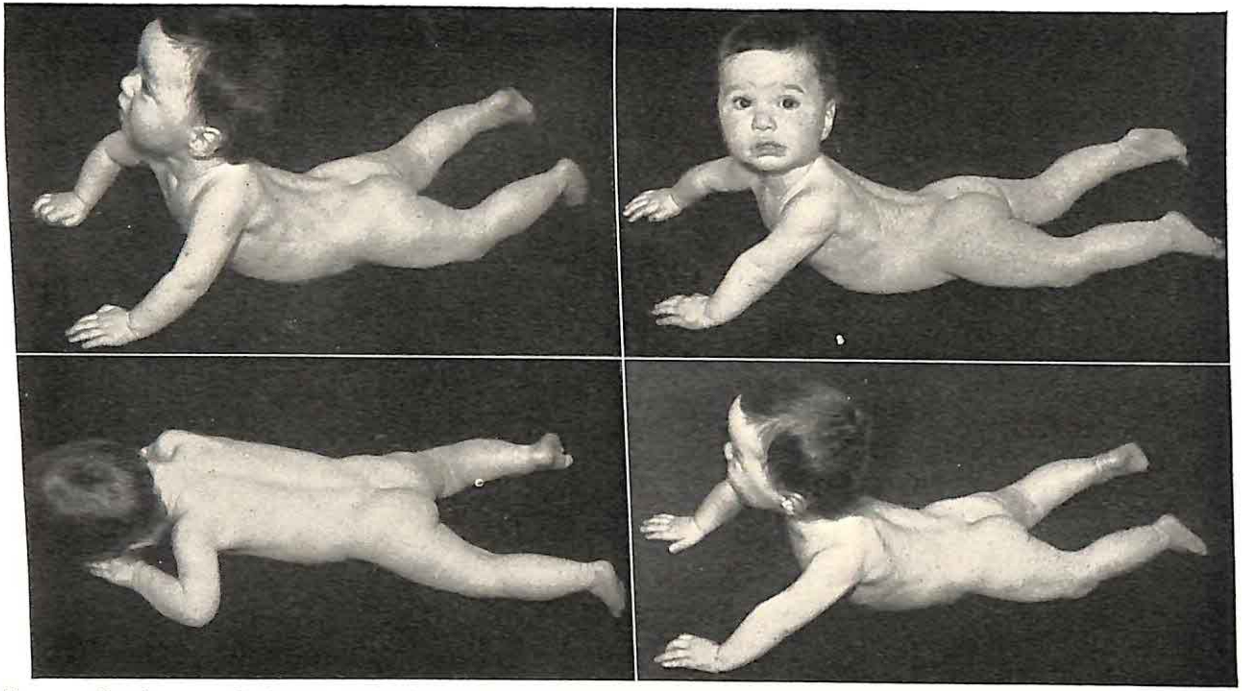


FIG. 53. By the age of sixteen weeks the baby can support his upper trunk for a limited period when prone and can move head and eyes in a co-ordinated fashion.

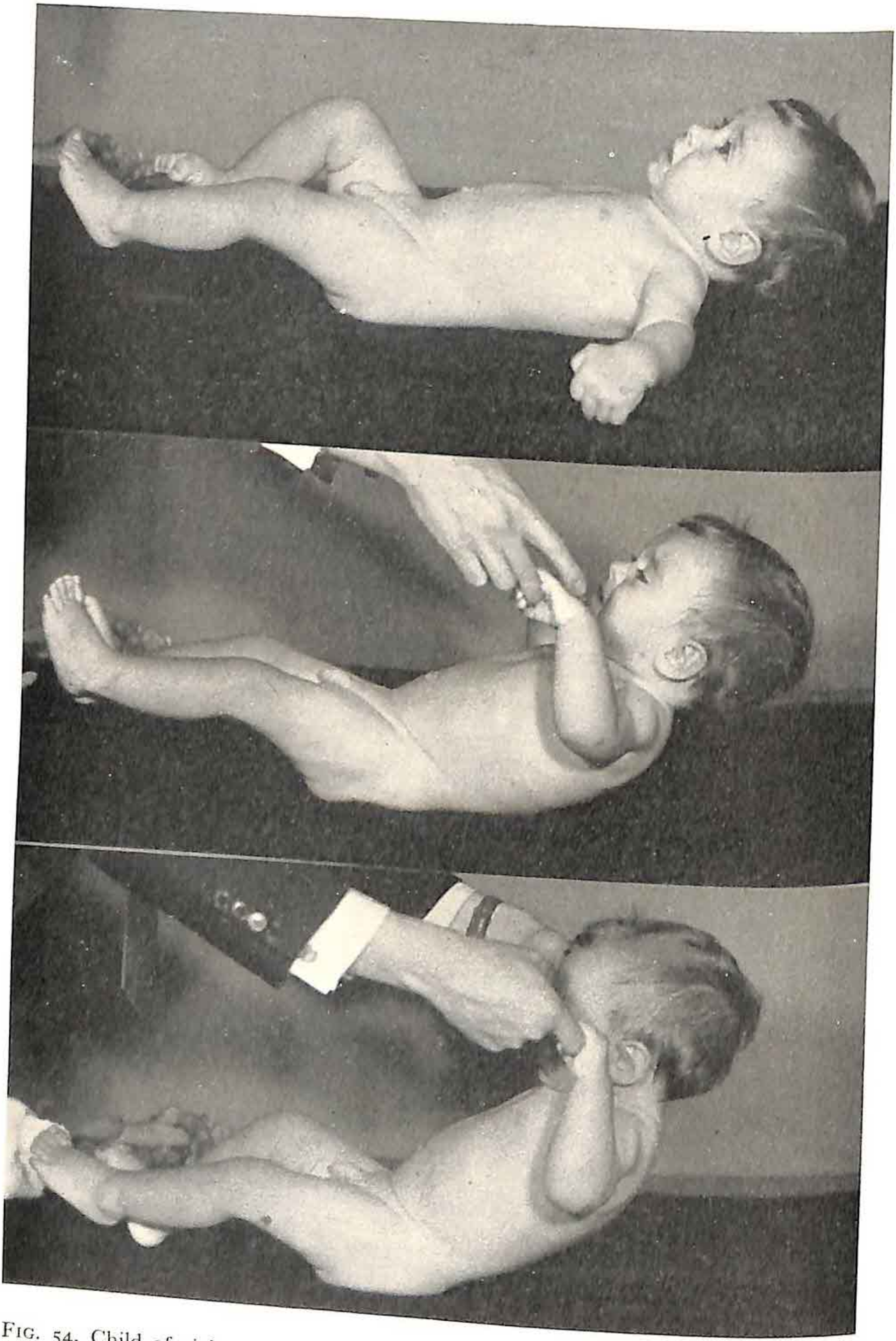


FIG. 54. Child of eight months showing characteristic use of the arms to help to pull himself from the supine to the sitting position.

associated reflexes become gradually less marked after the age of five or six months.

The vestibular apparatus can be shown to be active in the newborn baby, for if he is held in the examiner's hands and rotated, the eyes move first in the direction of rotation and then in the opposite direction when rotation ceases, and there is nystagmus. Vestibular reflexes become progressively important in maintaining the posture of the baby's head after the age of two or three weeks. Reflex changes in posture originating from retinal stimuli are not normally marked before the age of ten or twelve weeks.

After this age the reflexes arising from kinaesthetic, vestibular and retinal stimulation become more closely integrated and the infant's involuntary adaptation to changes in position becomes more efficient and complex. Eventually the fine, accurate, involuntary adjustments of posture, which are necessary components of effective voluntary movement, become established.

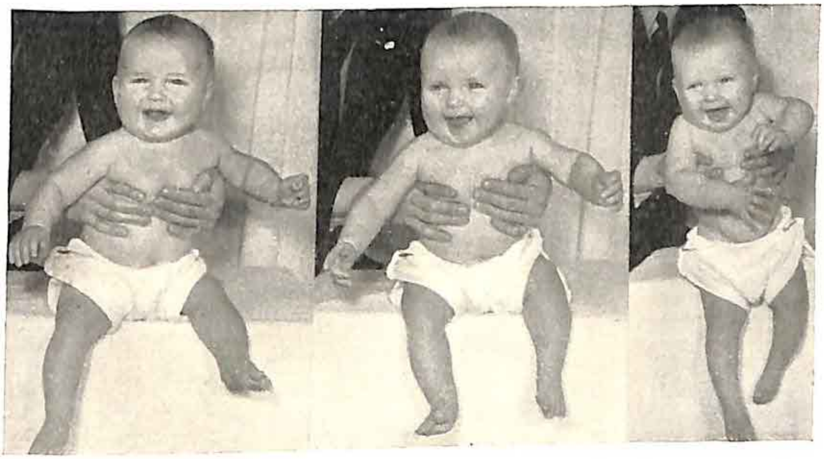


FIG. 55. By the age of four to five months supported sitting is possible and is much enjoyed.

Motor development in the first two years of life

During the first three months of life the integration of the tonic neck activity of the newborn with the higher-level vestibular and retinal reflexes, and their subsequent inhibition by cortical centres, allow the child to achieve much greater control of posture. There is greater variation in the positions of his trunk and limbs at rest and the tendency to generalised semiflexion becomes less evident. By the age of four weeks he can turn the head from side to side when prone and support it briefly when held in the erect position. By the age of six weeks he is usually able to follow bright objects moving near him for a few moments and by the age of sixteen weeks can focus on distant objects and keep them in sight by turning his head, twisting his upper trunk and moving his eyes in a co-ordinated fashion (Fig. 53). When he is supported at the level of the lower ribs he may be able to maintain the sitting position for some time. By the age of twenty to twenty-four weeks he can sit for longer with less support and is able to roll from the prone to the supine position. If placed in the standing position he momentarily takes a little weight on his lower limbs (Fig. 59).

As postural control improves, so the living platform to which the limbs are attached becomes steadier, and increasingly precise movements of the hands are possible.

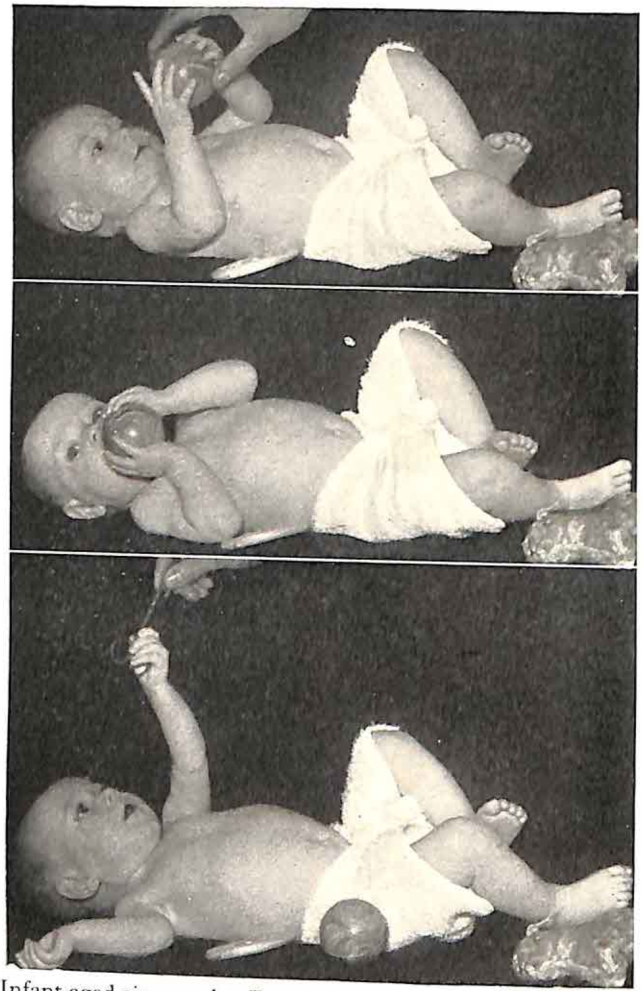


FIG. 56. Infant aged six months. From four to five months onward, he begins to reach for objects using all the fingers as a unit, and usually with both hands operating similarly. He explores things he picks up by putting them to his mouth and bites as well as sucks them.

The child usually reaches for objects two-handed at the age of about sixteen weeks but it is usually two or three weeks after this that he achieves useful grasping and places objects in his mouth. From the age of between twenty-four and twenty-eight weeks the baby may reach for objects one-handed with the fingers somewhat separated and opposed to the palm. Quite marked associated movements of the contralateral upper limbs are usually present when he does so.

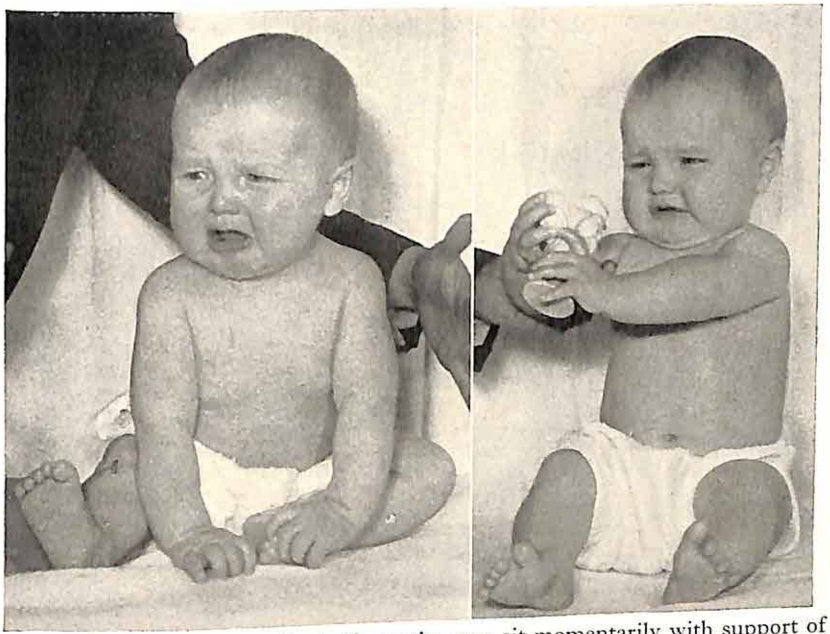


FIG. 57. Infant aged six and a half months; can sit momentarily with support of arms but not without; grasps objects with both hands.

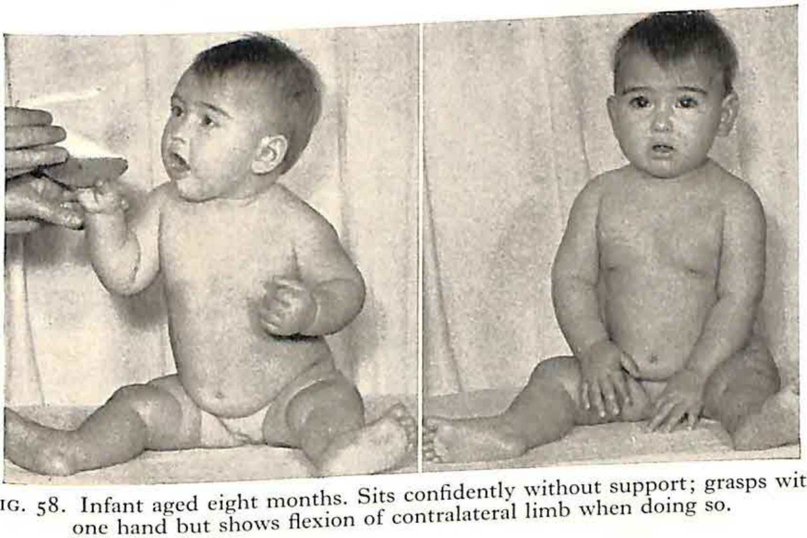


FIG. 58. Infant aged eight months. Sits confidently without support; grasps with one hand but shows flexion of contralateral limb when doing so.

Between the ages of twenty and twenty-four weeks the child becomes able to raise his shoulders and head from the pillow and look about him when lying in the supine position and by another eight or nine weeks independent sitting is usually possible. Initially the infant tends to put some of his weight on to his hands, placed anteriorly between his legs, in order to gain more stability (Figs. 57 and 58). When placed in the erect position he takes more weight on his legs and enjoys being bounced or swayed from side to side with his feet

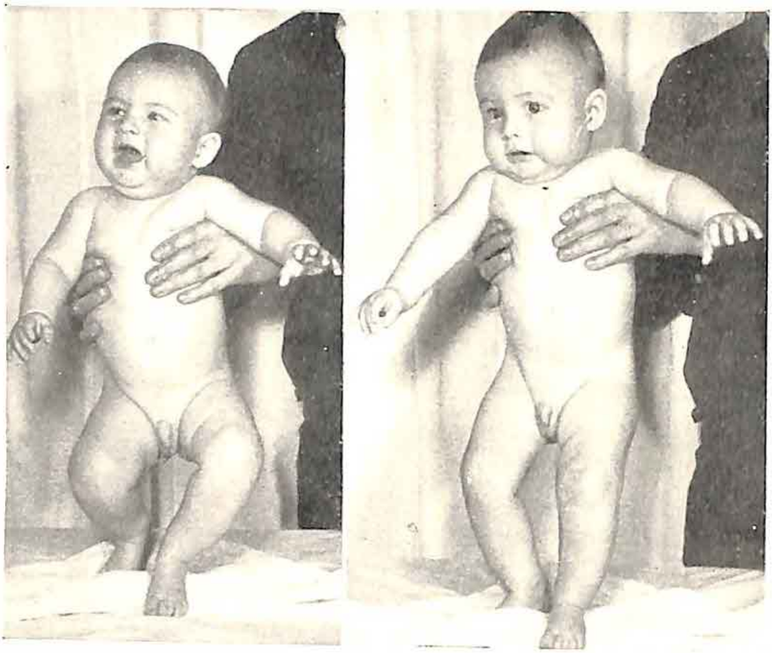


FIG. 59. Infant aged five months. Momentarily takes a little weight on legs when held.

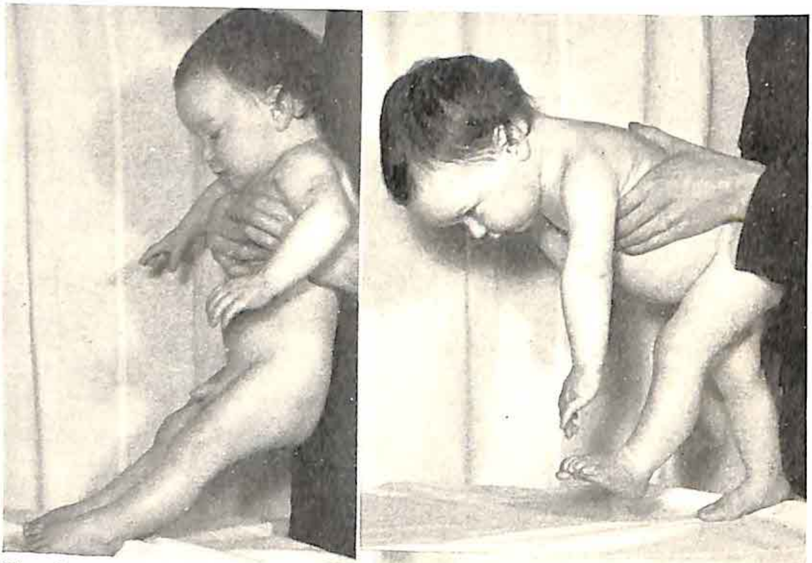


FIG. 60. Falling reflex of Magnus. When the infant is tilted forward quickly, there is a reflex stepping forwards movement, and the extended upper limb is placed anteriorly as though to break a fall.

on the ground. When he is quickly tilted forwards from the upright position he may show a reflex stepping forward movement and place his extended upper limb anteriorly as if to break a fall—the falling reflex of Magnus (Fig. 60). Co-ordinated crawling movements of the limbs are usually evident by the age of

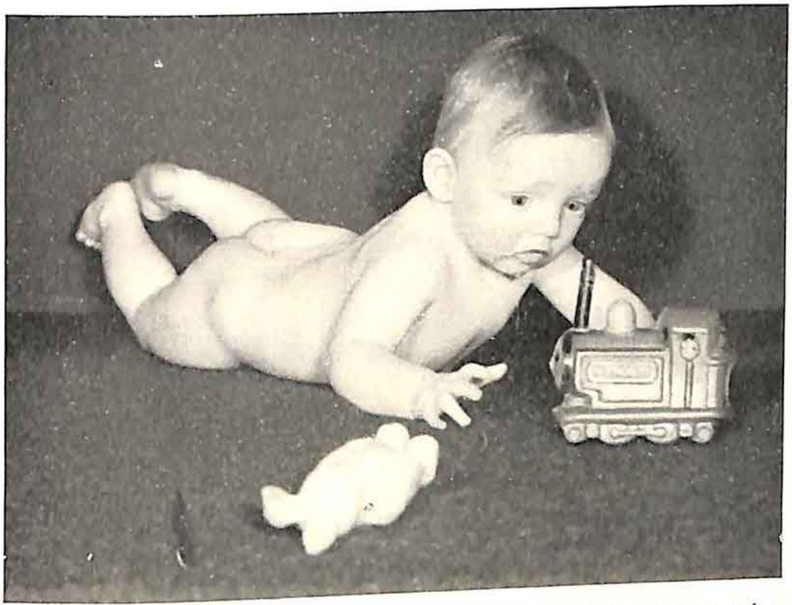


FIG. 61. Crawling on the abdomen is achieved by most babies between the ages of seven and nine months, but the amount babies use crawling as a means of progression is extremely variable.

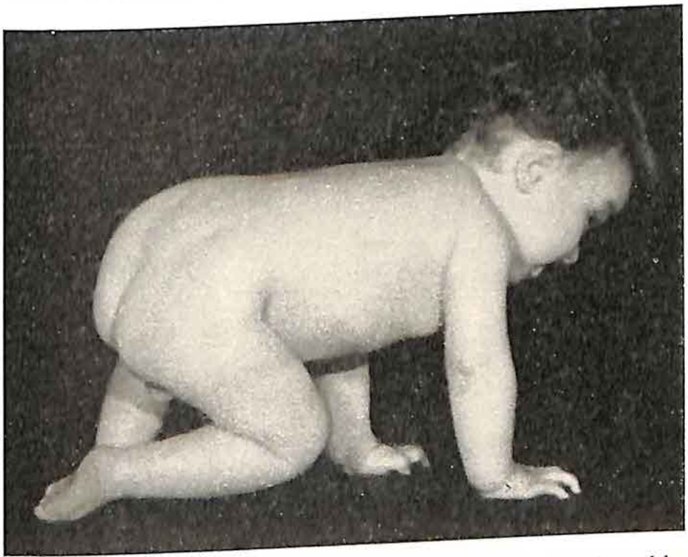


FIG. 62. By the age of ten months crawling is usually on hands and knees, and the limbs are moved reciprocally.

about thirty weeks when the child is prone, but only at the age of between thirty-six and forty weeks has he enough motor control and strength to lift the trunk clear of the ground and thus to crawl effectively (Figs. 61 and 62). Between thirty-six and forty weeks the infant becomes able to use the hands independently without marked involuntary associated movements of the contralateral upper limbs (Fig. 63), and he derives great pleasure from clapping his hands and changing toys from one hand to the other. A little later he begins to grasp with the thumb and fore-finger and much finer manipulation becomes possible than hitherto. Voluntary release of the grasp becomes possible. Interminable dropping of objects from his pram becomes a joy.

At the age of about forty weeks the infant begins to pull himself on to his knees by holding on to furniture, and he stands with support some weeks later, usually between the ages of forty-five and fifty-two weeks. The length of time for which normal children crawl and the methods they employ for doing so are extremely variable. The majority stand and take their first steps without support before the age of sixty weeks, and, thereafter, walk progressively more and crawl less (Fig. 64).

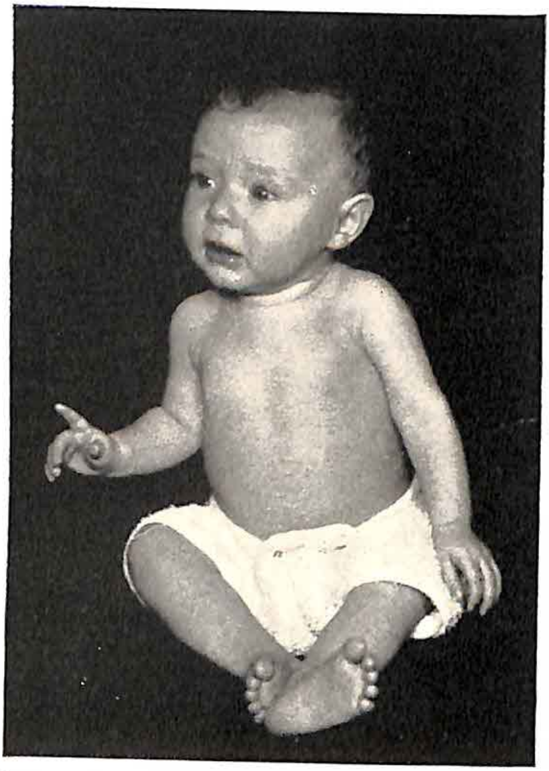


FIG. 63. Infant aged ten months. Independent use of right hand without flexion of contralateral limb.

Initially the child walks with the feet wide apart and tends to reach for support after every few steps, but by the age of eighteen months, most babies are walking with confidence on a much narrower base and are able to climb upstairs holding onto banisters. By the age of two years they should be able to run, to descend stairs, take a few steps backward and kick a ball without toppling over.

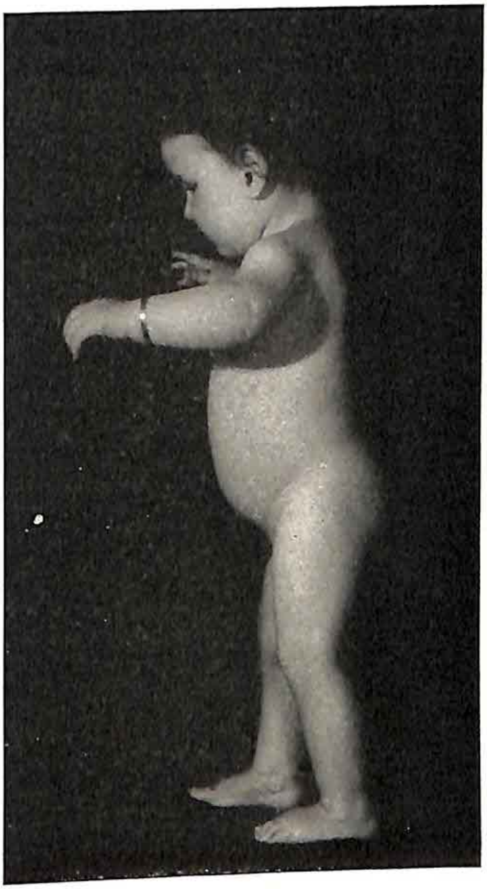


FIG. 64. Early unsteady steps, aged eleven months, using elevated upper limbs to help balance.

Linguistic development

Babies vocalise from the time of birth. Initially the sounds they produce are simple vowels, most often 'a', 'e' or sounds resembling these. The number of vowel sounds increases in the first weeks of life. Most babies produce their first consonants, commonly sounds like 'g', 'k', 'r', 'l' and 'z', before the age of three months (Lewis, 1963).

Initially the major stimulus to vocalisation is discomfort, especially hunger, though even at the age of a few days an infant may begin to cry when a crying baby is brought within earshot. By the age of three months, however, there is vocalisation in states of comfort as well as discomfort. The sounds produced in these states differ. Lewis explains the differences by pointing out that the child's lips, tongue and palate tend to assume different positions according to whether he is hungry (when, for example, he makes sucking movements with his lips) or satisfied (when the tongue may fall back and rest against the soft palate).

Characteristically it is in the third month that the child begins to babble repetitive chains of sounds when comfortable, and the sound sequences become increasingly complex in ensuing weeks.

It is easier to observe vocalisation in babies than to assess the extent of their appreciation of speech. Babies can be shown to respond to loud noise by blinking or screwing up their eyes shortly after birth. By the age of two months many respond to the sound of the human voice by smiling or vocalising and by the age of five or six months a child may smile at the sound of familiar voices but not at the sound of those which are unfamiliar. From this time he may also begin to react differently to speech uttered in a friendly tone and speech uttered in an unfriendly tone. Between three and six months the child's tendency to vocalise when he is spoken to becomes more constant and from the age of nine months he begins to identify parents, sibs, pets and toys when they are named to him. He obeys simple commands like 'clap hands' or 'kiss' by the age of twelve or fifteen months.

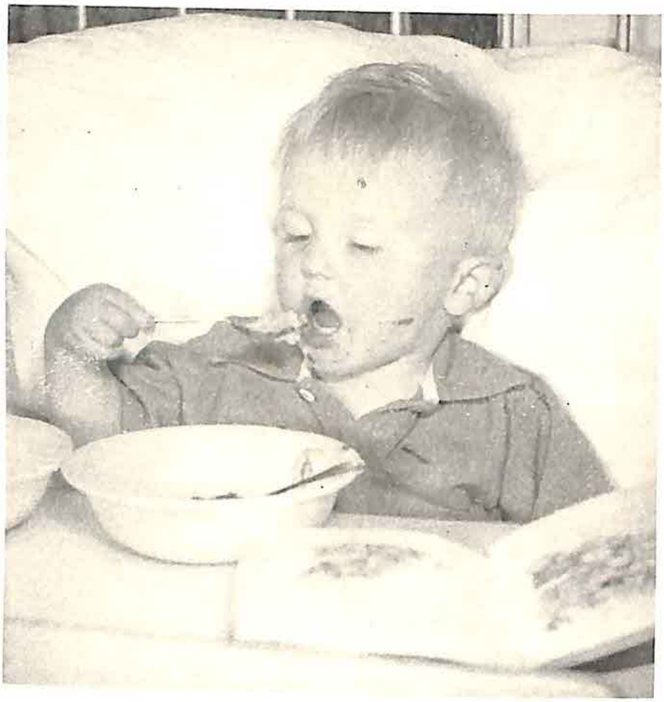


FIG. 65. Children of fifteen to eighteen months can usually hold a cup two-handed and drink from it without too much spilling. Using a spoon becomes possible a little later. Pouring is usually uncertain until after the age of two years.

The increased understanding of speech which is evident during the middle of the first year of life is not matched by an equivalent advance in the complexity of vocalisation. Many authors have commented on an apparent 'latent period' of speech development between about four and ten months of age—the period of repetitive babbling. From ten or twelve months of age, however, another spurt in speech development occurs. The intonation and rhythms of adults' phrases are imitated more and more accurately, though the actual numbers of consonants and vowels consistently and accurately articulated remain surprisingly small for some months more (Leopold, 1937, 1949).

It is difficult to determine the precise time at which a child utters his first 'word'. Parents eager for signs of progress in their children often mistake repetitive babbling for the meaningful use of words. Miller (1951) illustrates this point well. 'If, for example, the father walks into the room with a bottle of water for the baby he is very likely to catch the baby saying "dæ" or "ba" or "wa", any of which can be taken to represent the baby's approximation of "daddy", or "bottle" or "water".' However, most babies utter constant sound sequences regularly in appropriate circumstances at about twelve months of age, and may be said to have words (McCarthy, 1954).

The first meaningful words produced by the child usually consist of single vowels and labial, labiodental or alveolar consonants, such as 'p', 'b', 'm', 'w', 'f', 'v', 't', 'd', 'n'. Syllables are commonly repeated to form words like 'mama', 'baba' or 'dodo'. To begin with, the child makes do with perhaps two or three vowel sounds (each one of which may represent several of the sounds in adult speech, though identical to none of them) and a few consonant sounds. As the child matures, the vowels he uses become progressively differentiated and more like those of the speech which he is hearing, and he articulates increasing numbers of consonants correctly. In Newcastle it was found that 11 per cent of 114 children studied were unintelligible because of defective articulation of consonants at the age of three years and nine months. 'th' 'r', 'sh' and 's' are particularly often omitted or replaced even in children of four years or more, though these sounds may have occurred repeatedly in earlier babbling (Morley, 1957).

The rate of vocabulary gain varies greatly from child to child according to innate endowment, the amount and type of speech which the child hears and the extent of his other interests. Templin (1957) demonstrated a larger vocabulary in pre-school and young school children of upper socio-economic status than in those of lower socio-economic status. Like other investigators she found there was a close correlation between the size of passive and actively used vocabulary and intelligence, especially in children under the age of five years. Most authors have found that there is a rapid increase in the number of words the child uses between the ages of twelve and fifteen months, some slowing in the rate of the acquisition of vocabulary in the next three months and then a period of rapid vocabulary growth from the age of about eighteen months. It has been suggested that there is often a plateau in language development while the child is mastering a new motor skill, and especially while he is learning to walk. Smith (1926) estimated that the average two-year-old had a speaking vocabulary of 272 words; but a proportion of intelligent, healthy children have no words by this time. The speech development of mentally subnormal children is commonly seriously slowed but retarded speech development may be due to a large number of other causes, including impairment of hearing, the developmental speech disorder syndrome, psychiatric disturbances and environmental deprivation (Ingram, 1959).

It is possible to analyse a child's speech in terms of the traditional grammatical categories used by adults and to record the appearance of 'nouns', 'verbs', 'adverbs' and so on. However it is now coming to be recognised that these categories are in some ways unsatisfactory when applied to the speech of young children. A word like 'more' or 'nuf' (enough) may initially serve as a whole sentence. 'Milk', for example, may be a one-word sentence meaning 'I want milk'. By the age of two years most children are able to produce a number of two-word sentences, such as 'Want milk' (Morley, 1957), but their utterances come only gradually to conform to the grammar of the adult language. In view of this, attempts have recently been made to produce grammars which adequately describe the speech of young children, but the task is a very complex one and much research will be required before the appropriate descriptive categories can be developed (Brown and Berko, 1960; Bellugi and Brown, 1964; Robins, 1964).

When analysis is made in terms of the traditional 'parts of speech', nouns and verbs are observed to appear first. Adjectives and adverbs follow, while prepositions, pronouns and conjunctions normally come last. Personal pronouns understandably cause difficulty. The child has to learn to refer to himself as 'I', whereas everybody refers to him as 'you'. Mastery of this reversal is usually achieved by the age of two and a half years. It may be regarded as an indication that the child is developing the ability to consider a situation from some point of view other than his own. This ability is regarded by Piaget as being of great importance in the course of conceptual development.

As children become more fluent, they form sentences which contain several words but which are still often deficient in articles, prepositions and conjunctions. By the age of three or four, though these grammatically incomplete sentences are still common, quite complete and even elaborate sentences are being spoken, containing all parts of speech, plurals and a variety of tenses, and having complex and compound syntactical form (McCarthy, 1954). Templin (1957) found that half of the remarks of three-year-old children were grammatically correct using traditional descriptive grammatical categories and that the proportion of incomplete sentences decreased with age.

Children find particular difficulty in using conjunctions expressing closely specified relationships such as 'because', 'if' and 'unless'; they replace these conjunctions with 'and' to string component clauses together and form sentences. It is commonly found that conjunctions are first used correctly in practical situations before the child can use them in the formal situation of psychological testing. For example, a child of four, when asked why he is crying, may be able to answer 'Because I hurt my leg', if he is, in fact, crying because he hurt his leg. But Piaget (1928) finds that children of seven, asked to complete the sentence, 'I had a bath because . . .', may continue 'because afterwards I was clean'. In this case the word 'because' is being used like 'and' to connect two clauses describing a simple temporal sequence. Watts (1944) found that 50 per cent success in a formal test of the ability to use various conjunctions was not achieved until over the age of eight years in a group of children of above average ability.

Adaptive Behaviour

In the process of growing-up, a child frequently encounters situations which contain some element of difficulty or novelty. When he contrives means of dealing successfully with these situations, he may be said to 'adapt' to them. In a sense many of the everyday activities which the normal child learns to carry out for himself are tests of 'adaptation'. Using a spoon efficiently, drinking from a cup, learning to take one's own socks and shoes off, undressing and dressing, and toileting may be regarded as forms of adaptive behaviour. An observant mother carefully questioned about her child's practical abilities in the home setting can often give information which allows a reasonably accurate measure of adaptive behaviour development to be made. Gesell and Amatruda (1947) give norms for these everyday adaptive skills. For example, the child may be expected to be capable of taking some part in feeding himself by eighteen months. By twenty-one months he should handle a cup well and by three years he should be feeding himself quite efficiently. He may begin to co-operate in the processes of putting his clothes on as early as twelve months, but not till twenty-four months will he normally be able to pull on simple garments unaided. At the age of three years he should be able to put on his shoes and to undo buttons if they are easily accessible. When he is five he may be expected to be capable of dressing himself without assistance provided he has not too many difficult buttons and is not expected to tie his laces.

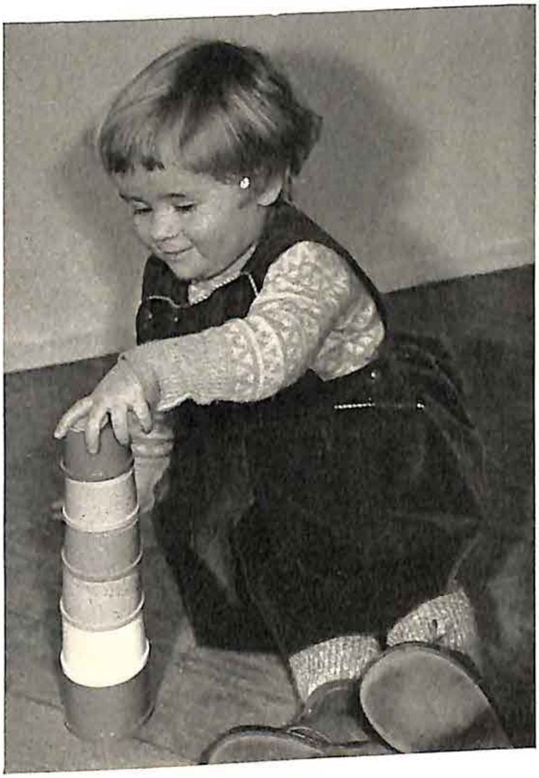


FIG. 66.

Whilst these activities may give valuable indications of the child's progress, it is, however, possible to assess adaptive skill more formally and accurately by presenting the child with a selection of standard tasks and problems appropriate to his age.

It is obvious that, whatever problems one chooses, they are bound to elicit behaviour which would be included in one or more of Gesell's other three categories. The child cannot solve a problem without moving or speaking, and his success will often not be independent of his emotional or social maturity. So the lines separating adaptive behaviour from motor, linguistic and social behaviour cannot be precisely drawn. When the child is very young the problems must call for motor rather than verbal responses. Tasks which do this are known as 'performance tests' and they are useful at all ages, though verbal problems become increasingly important as indices of development as the child grows older.

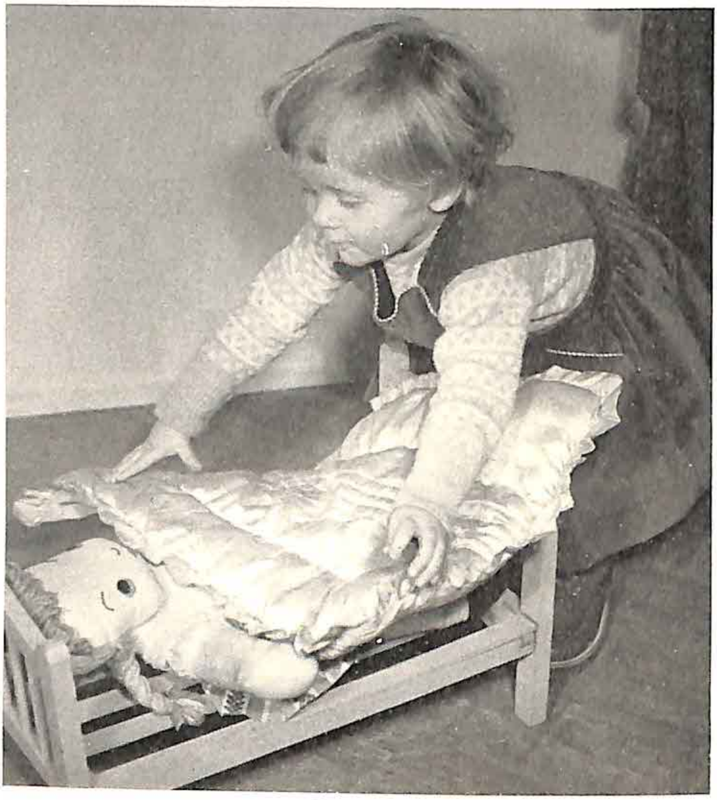


FIG. 67.

FIGS. 66 and 67. Child of two years at play. By this age the child can build a tower of six or seven blocks or beakers and can turn the pages of a book. Fantasy play becomes progressively more important during the latter part of the second year and motor skills are sufficiently developed for this.

Gesell assessed the adaptive behaviour of children under five years of age by means of such tasks as building with small wooden blocks, placing objects in containers and removing them, fitting wooden shapes into their corresponding holes in a wooden square, (the 'formboard' test), drawing, repetition of digits and sentences, and using a stick or chair to reach an otherwise unattainable toy. The child of eighteen months is normally able to build a tower of three or four blocks in imitation of one built by the examiner, put a number of cubes into a cup and empty it again, scribble spontaneously and make some attempt at tackling a simple formboard. By the age of two years, he may be expected to build a tower of six or seven blocks (Figs. 66 and 67), imitate a V or a circular stroke with a crayon, repeat three or four syllables correctly immediately after hearing them and fit a circle, square and triangle into a formboard. By the age of three years representational drawing has become possible. The three-year-old will frequently name his drawing though usually only after the drawing has been completed. He may offer several alternative titles. He can imitate a drawing of a cross though he is still unable to draw a cross if shown a model of one. Gesell reports that it is in general harder for children to copy a model than to reproduce a drawing. The three-year-old child can normally repeat a series of two digits after the examiner and may manage three. He should be able to repeat sentences of up to six or seven syllables. (Difficulty, of course, depends on the meaning of the sentence as well as on its length in syllables.) Working with building blocks, the child of three can copy a 'bridge' of three blocks, one spanning the space between the other two, when its construction is demonstrated for him. By the age of four years he can copy a 'gate' built with five blocks, can add missing parts to an incomplete drawing of a man and draw the shape of a cross from a model. Gesell reported that one sentence of as many as thirteen syllables was successfully repeated by 50 per cent of his four-year-old subjects.

These norms give some indication of what may be expected in the pre-school years. Tests, other than the Gesell Schedules, which are commonly used at these ages are the Terman-Merrill Intelligence Scale, the Merrill-Palmer Scale of Mental Tests and the Minnesota Pre-School Scale. Tests for older children traditionally emphasise ability to classify, to complete analogies, to extrapolate series, to perceive absurdities, to carry out fairly complex instructions and to solve problems of a logical or mathematical nature. But they also include items similar in nature to the Gesell tests for under-fives. For instance, in the Terman-Merrill Scale, copying a diamond is placed at year seven and digit repetition is still being used at adult levels.

When children have learned to read and write, it is possible to use tests, such as the Moray House series, which can be administered to a group. It is generally agreed that individually administered tests, such as the Terman-Merrill and the Wechsler Intelligence Scale for Children, are still to be preferred when circumstances make it possible to use them; but they depend to a much greater extent than the group tests on the skill and experience of the tester.

On some tests the value of the Intelligence Quotient (I.Q.) is arrived at by first calculating the child's 'mental age' (M.A.) and then expressing this as a percentage of his chronological age (C.A.). A child is said to have a mental age of 8 years 0 months on a test if his score is the average score for children of that chronological age. If his chronological age is also 8 years 0 months, then his I.Q. will be 100. If his chronological age is less, his I.Q. will be more than 100; if his chronological age is more, his I.Q. will be less than 100. For example, a child of 10 years with a mental age of 8 years has an I.Q. of $\frac{8}{10} \times 100$, that is, 80.

In a test of this sort, the items are grouped by age level. The child has then a mental age of eight if he passes all the items at this level, or, as more commonly happens, if he passes all the items for year six or seven and raises his mental age to eight by getting additional credits for scattered successes higher up the scale. Not all tests are arranged on this basis, however. Often there is no division of items into age levels, and indeed the test may be suitable for use only within a quite restricted age range—say, ten years six months to twelve years six months. In this case, the child who makes the score which is exactly average for his age still gets an I.Q. of 100; but an I.Q. of 75 gained by a twelve-year-old child does not then mean that he has made the same score as the average nine-year-old. It means rather that 10 per cent of the twelve-year-olds were below him in score—or that he fell at the '10th percentile' of his age group.

It is important that an intelligence quotient—or any other test result—should be interpreted in the light of knowledge of the test on which it was obtained and of the basis on which that test was standardised.

Intelligence tests are used both to estimate a child's present status in relation to his peers and to predict his future mental growth. The chances of achieving good prediction are affected by the age of the child at the time of first testing and the length of the period over which prediction is attempted; the younger the child and the longer the period, the less will be the likelihood of accurate prognosis. Bayley (1949) finds that scores on tests given before two years of age are quite unrelated to scores during school ages. However, tests given between two and three have a correlation of ·70 with tests given at five, six and seven, and of ·54 with tests given at seventeen and eighteen. Once the child reaches school age, correlations drop much less sharply than before as the age interval between tests is increased—that is, long range predictions achieve greater success. But there is now evidence to suggest that accurate prediction on the basis of any one test score is limited by the fact that mental growth, like physical growth, proceeds according to different patterns of spurt and pause in different individuals. Evidence of variability of this kind emerges from both the Berkeley and the Harvard Growth Studies (Bayley, 1956; Cornell and Armstrong, 1955); and some of the findings suggest that it may become possible to use two or more scores in such a way as to identify the form of an individual's mental growth curve and so obtain a very appreciable increase in predictive accuracy.

One outcome of the study of growth patterns is the evidence of a correlation between early puberty and success both in intelligence tests and in school work. It has been known for some time that, for constant chronological age, greater physical maturity tends to be associated with higher scores in mental tests (see Tanner, 1961). Douglas (1964) reports that, in a large sample of girls, those who were showing some signs of puberty by age eleven did consistently better not only in tests administered at that time but also in tests administered earlier at age eight and in school work. Teachers reported that the early maturing girls worked harder, could concentrate better and were easier to discipline. Care was taken to allow for social background and the observed differences cannot be explained in terms of social class alone. Douglas does not, however, believe that the observed relationship between greater physical maturity and superior ability indicates any causal connection between the two. He points out that both early sexual development and superior performance in school work and mental tests tend to be related to family size, only children and members of small families having the advantage in both cases. If only children are considered as a separate group, then at age eleven their measured ability bears no relation to their sexual maturity.

It would be quite false to conclude that findings of correlation between early physical maturing and higher test scores are enough to cast doubt on the tests' value. Rather they suggest that this value may be increased when it becomes possible to interpret scores in the light of a better understanding of growth trends.

An advance of this kind would consist in the more knowledgeable use of existing tests. But advance may also result from improvement in the instruments. The most powerful criticism of the tests at present in common use has come from Jean Piaget and his colleagues in Geneva. Piaget (1950) claims that the tests are at best only indirect measures—that they assess the outcome of the cognitive changes which occur as development progresses but do not reach and reveal the changes themselves. Piaget considers that the development of intelligence proceeds in a number of distinct stages, each growing from and building upon the preceding one. The first is the 'sensorimotor' period, lasting till the age of about eighteen months. The critical achievements of this period are the development of the ability to organise movements in space (so that one movement can be understood to reverse or cancel out another and so that detours become possible) and the development of 'object constancy'. By 'object constancy' is meant the notion that an object continues to exist when it leaves the perceptual field. The child of less than nine months will not usually search for a toy when it is covered by a cloth, even though he can be shown to be capable of removing the cloth and has been much interested in the toy. But from then on, he will begin to look for objects which have disappeared from view.

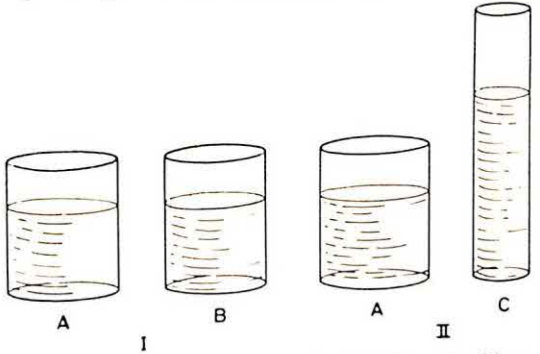


FIG. 68. Conservation of amount of liquid (Piaget). Glass A remains unchanged, while the liquid is poured from B into C.

The appearance of object constancy probably indicates the beginning of truly conceptual experience since it implies the ability to represent something which is not actually impinging upon the senses. The growth of the capacity for representational or symbolic thought occupies the period from eighteen months to roughly seven years and shows itself not only in increasing linguistic skill but in make-believe play and other imaginative activity, in the increasing capacity for deferred imitation (that is, imitation occurring after an interval of time) and, generally, in the extension of ability to conceive of events happening at some distance in time and space. Piaget calls this period 'pre-operational' by contrast with the next one, which extends from age seven to eleven and is described as the stage of 'concrete operations'. He defines mental 'operations' as internalised, reversible actions. By the end of the sensorimotor stage, as we have already seen, physical actions have achieved a certain organisation which is characterised by reversibility or the apprehension of how one action and the reverse of that action bring one back to the starting-point. During the pre-operational period, with the growth of the symbolic function, internalisation of actions becomes possible: that is, it becomes possible to perform them 'mentally' and so to anticipate their outcome. Not till the stage of concrete operations, however, do these mental actions become organised in reversible systems so that the two criteria of internalisation and reversibility are at last combined. Piaget demonstrates the new development by setting tasks of which the following is a typical example. The child is shown two glasses of the same shape containing the same amount of liquid (see Fig. 68). Let us call these A and B. When the child has agreed that the amount in the two glasses is the same, the liquid from B is poured, while he watches, into a third glass of different shape—say, taller and narrower—which we may call C. The child is then asked whether there is now the same amount in A and C. According to Piaget, the conviction that the amount must be the same now if it was the same previously comes only when the stage of concrete operations has been reached, for it depends on the notion (not necessarily explicit) that the action of pouring could be reversed and one would then be back exactly where one started. The emergence of a conception of some constant or invariant—in this case, amount of liquid—in spite of transformations—in this case, changes in shape—is held by Piaget to be a critical sign of the presence of operational thought.

Until adolescence, however, the capacity for operational thought is held to be limited in a number of ways. While the child is still at the stage of concrete operations, his reasoning consists in an attempt—increasingly wide-ranging and successful—to co-ordinate facts about the actual world. About the age of twelve he becomes capable, according to Piaget, of genuinely hypothetical reasoning, where the focus of attention shifts from the actual to the possible. Concern is now with implication and with deductive necessity. Piaget (1953) quotes Ballard's nonsense-sentence test: 'I am very glad I do not like onions, for if I liked them I would always be eating them and I hate eating unpleasant things', and claims that the child who is at the stage of concrete thinking criticises the data, saying, for instance, 'Onions are not unpleasant', whereas subjects who have reached the stage of formal thinking merely point out the contradiction between 'onions are unpleasant' and 'if I liked them'. There is no doubt that the capacity to accept premises as pure hypotheses and reason from them does increase markedly in early adolescence.

Whether one accepts the Piagetian view of development or not, it is certain that between the ages of five and twelve the normal child in our culture acquires certain fundamental cognitive skills and develops certain highly important concepts. He learns to classify and to arrange in series, for example; and he develops his notions of time and space and number. The kind of development that occurs may be illustrated by the case of classification. If a child of five is given objects to classify—say, a set of geometrical figures—the most notable feature of his response will probably be the absence of any overall plan or scheme of classification. It has been shown that very young children can perceive the similarities and differences which must form the basis of any such classificatory scheme: thus two-year-olds can maintain a learned positive response to a triangle in spite of rotation of the figure, variations in size and some variations in shape (Gellermann, 1933). But to perceive the relevant similarities and differences is not necessarily to have the ability to use them in a systematic classification. A typical five-year-old response to a request to 'put together the ones that are the same kind' is to place side by side two objects alike in some respect (*e.g.* in shape) then to pick up a third object and relate it to the second one on the basis of some other criterion (*e.g.* colour). Thus the child may put together a red square and a blue square, then add a blue triangle. But though he changes criterion in seemingly haphazard fashion at this age, he cannot readily do so intentionally. Having once established a classification on the basis of colour he cannot break it up again and regroup on the basis of shape—not until age six on the average according to Piaget and Inhelder (1959) or even later according to Reichard, Schneider and Rapaport (1944).

Another immature response is the construction of patterns or the use of the geometrical forms to represent objects, *e.g.* a house. And when the child is given toys, model figures and objects of various kinds to sort instead of geometrical shapes, then grouping by situational relevance is common. He may put a man, a chair and a pipe together because the man sits on the chair and smokes the pipe. Or again, he may tell a quite elaborate story by means of which objects are linked together.

It is important to observe that this kind of sorting behaviour is not confined to children. A proportion of adults with serious brain damage will respond to classificatory tasks in ways very similar to those just described. Goldstein and Scheerer (1941) report a number of cases of this kind and draw a distinction between what they call the 'abstract attitude' and the 'concrete attitude'. The concrete attitude, as they observed it in their patients, is realistic and unreflecting. When it prevails, the individual is at the mercy of the impression of the moment. Thus he cannot see an individual thing as representing an abstract category or deliberately consider a number of different ways of classifying a given set of objects, as the normal adult is able to do. However, Goldstein and Scheerer point out that even normal adult subjects may on occasion show all the signs of 'concrete behaviour'. The difference between normal adults on the one hand and children and certain brain-damaged adults on the other is that the former are *capable* of assuming the abstract attitude whereas the latter are not.

It is not easy to place the first appearance of this capacity at any one point in development. Goldstein and Scheerer regard the ability to shift from one sorting criterion to another as a very important index, and this has been judged to develop by age six or seven, as we have seen. However, it is certain that some of the other signs of abstract behaviour mentioned by Goldstein and Scheerer, in particular the ability 'to assume an attitude to the "mere possible" ' is not fully developed in most children till adolescence at the earliest. It seems that the change from one mode of thinking to the other stretches across the whole period of the primary school years.

Social Development

The child becomes increasingly able to fend for himself as he grows up and at the same time learns to behave in ways which are acceptable to the other members of the community in which he finds himself. In his first human relationship after birth, which is with his mother, the baby is completely dependent. During infancy, as he becomes more aware of himself and his surroundings, this relationship gradually becomes less dependent and more complex. In early childhood it remains the most important tie, though increasing numbers of other social contacts are made, first within the family circle and then outside it. But his relationship with the mother (or for that matter the relationships with other members of the family) is not a static one. It varies in character and intensity at different stages of the child's development and according to the mother's changing role.

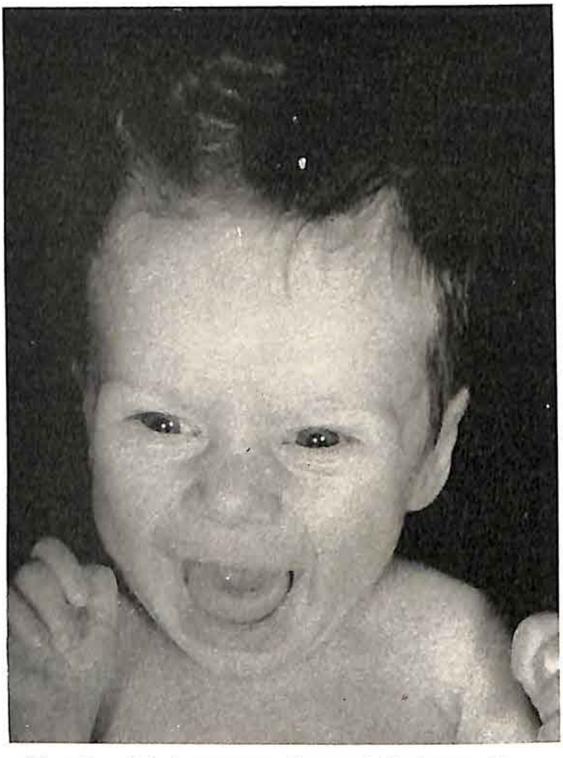


FIG. 69. A baby responding socially by smiling.

The social responses of the child have been studied from many different points of view. Piaget and his associates, for example, have been interested in the effects of intellectual development, particularly the growth of the capacity to adopt different points of view, on the child's social behaviour (Piaget, 1926, 1951). The contributions of conditioning to the development of social and emotional responses have been studied by Pavlov in Russia, by J. B. Watson in America and by their followers. Psycho-analytical explanations of the changing patterns of the growing child's social life as being the result of instinct transformation and of primitive sexual drives are discussed by Freud (1962).

The earliest response of the human infant which seems to merit the description 'social' is the smiling response (Fig. 69). Almost all children between the ages of two months and six months will smile in response to a smile, whether from someone familiar or from a complete stranger. Spitz and Wolf (1946) have shown, however, that the smiling response is also elicited by a lifeless mask, provided that certain conditions are satisfied. The main conditions are (*a*) that there be 'full-face' presentation of the mask; (*b*) that two 'eyes' be clearly visible; (*c*) that there be some movement. The child does not smile at a mask which is held completely still.

The fact that this response occurs in the presence of certain simple and precisely definable 'key stimuli' makes it seem to resemble a type of response which is common among animals, and especially birds. It appears that the young of many species are born with built-in tendencies to respond to certain fairly simple collections of stimuli, and that crude models or dummies can elicit these patterns quite as effectively as the natural objects. For instance, a pecking response in herring gull chicks which is normally a response to the lowered bill of the feeding parent-bird can be elicited by a small thin stick painted with patches of red against a white background and held upright. To human perception, this model bears no resemblance to the natural 'releaser'—the parent's bill—but the key stimuli are present, so the response appears (Tinbergen and Perdeck, 1950).

It is characteristic of these behaviour patterns in animals that they are elicited on first encounter with the appropriate stimulation, when the animal has had no opportunity to learn. However, it is doubtful whether the human smiling response is independent of learning. Spitz and Wolf found that, in the few instances where no response appeared or where the child screamed instead of smiling, there was evidence of a very poor mother-child relationship. Also they report the case of a child born two months before term and appropriately retarded in perceptual and motor development, who was nevertheless advanced in the smiling response and in social development generally. This advancement Spitz and Wolf attribute to a particularly good relationship with the mother.

After the age of six months, smiling in response to a mask or to any human face, known or unknown, begins to disappear. The child then starts to be selective. He may smile or babble and make grasping and reaching movements when his mother comes but turn away and be unresponsive with other people. From then on, he may be expected to show definite signs of recognising familiar faces but is likely to be shy with strangers. By this age he will often try to engage the attention of people in his activities and will play the game of giving and taking back toys and of hiding and revealing them.

There is no doubt, however, that the important social relationship of the first year is with the mother, or with the person who is caring for the child in the mother's place. There is ample evidence that, unless a warm and more or less uninterrupted relationship is established at that time, subsequent development may be adversely affected in many ways. It has been demonstrated that if children are deprived of maternal love and care for appreciable periods—say, three months or more—before the age of three years, they are liable to be retarded in physical growth and in motor, linguistic and adaptive behaviour. Also they may suffer limitation of their ultimate capacity to form relationships with other people, and there is strong evidence to suggest that severe early deprivation is important in the aetiology of delinquency (Bowlby, 1951). Many writers on the subject believe that the effects of deprivation are difficult, if not impossible, to reverse. But Clarke and Clarke (1960) argue that long-term recovery is not impossible. Also they stress a point which is now widely recognised (Bowlby, 1958), namely that some children appear to survive severe deprivation unharmed. But little or nothing is yet known about the conditions affecting individual vulnerability.

An enormous increase in the child's capacity for social exchange comes when language appears. At the same time the development of motor skills, especially walking and fine manipulation, makes the child increasingly able to explore and master his immediate surroundings. From the age of eighteen months he may begin to let his mother know when he needs the lavatory, and he is able to help to some extent in dressing and undressing. His decreased physical dependence has its counterpart in his growing sense of personal identity. He begins to distinguish between what he does and things that are done or happen to him. He is increasingly aware of his relationships with other members of his family and takes the initiative in making social contact with them. He may give his mother and brothers and sisters presents and enjoys playing and talking with them. He likes to help in the house and much of his play imitates what he has observed his parents and older brothers and sisters do. As described in Chapter 9, his relationship with his parents becomes much more complex.

The period between two and three years of age is characterised by behaviour that is traditionally described as 'negativistic'—that is, the child will frequently fail to obey instructions and may seem actively to resist them. It is usual to ascribe this resistance to the development of the feeling of being a person and to the growth of a tendency to self-assertion, and support for this interpretation has been held to be provided by the readily observed fact that a child of this age is more likely to obey a positive instruction, which may resemble an invitation, than a negative one, which is unmistakably a command (Baldwin, 1955). However, Luria (1961) reports findings which suggest that some at least of the 'disobedience' of this period may spring not from self-assertion but from the fact that the child's behaviour is still only very partially susceptible to control through the medium of language. Luria claims that, when language does begin to serve as an effective means of influencing behaviour, it is first the speech of others and only later the child's own speech which can fulfil this function. Further he claims that language can initiate behaviour before it can inhibit behaviour, a claim which is compatible with the observation that positive commands have a better chance than negative ones of evoking the response that is desired. Luria sees in language the indispensable instrument by means of which the individual ultimately becomes capable of exercising self-control and voluntarily directing his own attention or inhibiting his own impulses. The possible implications of his work for the study of social development and also for that of intellectual development are far-reaching.

The sense of possessing is well developed by the age of two years and toddlers of this age find it extremely difficult to share their toys. On the other hand they are frequently direct and violent in their methods of getting toys they want which belong to others. Because of their intensely egocentric attitudes, toddlers find group games without adult supervision impossible. The first stages of social play may be found, however, in the liking two and three-year-old toddlers have for playing beside, if not with, other children (Parten, 1932). Often, when playing in this way, the child will keep up a commentary on what he is doing, apparently for his companions' benefit, but in fact almost entirely for his own. This so-called 'collective monologue' may reveal very vividly the intensely individual and self-centred world in which the typical three-year-old child lives (Piaget, 1926).

The period from two to five or six years of age is often marked by very active fantasy, and the child at this stage cannot clearly distinguish fantasy from reality. For this reason he may tell the most incredible stories of events which he appears to believe have actually happened. He is often regarded as a liar in consequence but 'truth' can hardly be expected until the worlds of reality and fantasy become less closely interwoven. This commonly occurs from the age of five or six years onwards.

The three or four-year-old is keenly interested in his own body and the attributes of others, and his questions are likely to include ones relating to birth and sex. Manifestations of infantile sexuality may bring him into conflict with adults, and undue repression or evasion of his questions at this time is liable to affect his subsequent social development.

It is sometimes said that the child of four wants independence but the independence he wants is certainly only partial. There is a conflict between this desire and the wish to return to the privileged, passive condition of infancy. Similarly, the parents are often in conflict between their desire to have a mature, competent child, advanced in such matters as toilet training and general self-control, and their desire to keep him small and dependent. The outcome of these conflicts varies enormously, but by the time the child goes to school the first social crisis is generally over and a more stable pattern of relationships between the child and his family has been established.

The main social change in the primary school years is the shift in emphasis from relations with adults to relations with contemporaries. The young school child tends to regard the teacher as an ally to whom he may look for help and support in the face of threats arising from other children. He may compete quite openly for the teacher's attention and favour. But as he grows older he turns more and more to his contemporaries. From the age of seven or eight years there is a tendency to 'gang up', especially in boys, and a widening environment is explored by groups of five or six or more children who have constantly shifting relationships one with the other.

The gang is commonly a very exclusive social group and sex, religion, school, social class of father or physical development may affect eligibility for membership. Children from different social backgrounds, with physical peculiarities or with unusual interests are unlikely to be accepted and are often treated quite intolerantly. Within the gang, members compete in the accepted activities which may conflict with adult standards (see Chapter 19). On the other hand the gang does help to develop the child's sense of belonging to a community outside his home, a fact which tends to be ignored when gangs are said to be at the root of so much delinquency.

The transition from this latest stage of childhood to full social maturity and adult status may be spread over very varying lengths of time and be achieved with varying degrees of emotional stress and social upheaval.

T. T. S. INGRAM, MARGARET DONALDSON

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Chapter 9

EMOTIONAL DEVELOPMENT

'Childhood has its own ways of seeing, thinking and feeling; nothing is more foolish than to try and substitute our ways.' Rousseau.

Relevance of the Subject

It is hard to realise that it is just over 200 years since Rousseau published the first account of emotional development based on the direct observation of children (Grange, 1963). The above quotation, so reasonable to the informed contemporary ear, signifies an intuitive grasp of the whole subject so far in advance of its time that '*Emile*' has suffered long neglect. Even his few supporters who were interested in Rousseau's revolutionary ideas on child development did not seriously regard them as having any practical significance. It is unfortunately true that even today it is still necessary in some quarters to justify the study of the beginnings of the human mind and of human behaviour as a matter of no mean importance in the practical affairs of man.

At the outset then, let us consider the claims of this subject for our serious attention. Firstly, there is the 'pure research' attitude which values discovery for its own sake. Secondly, there is the goal of establishing norms so that the earliest signs of deviation may be detected, and this has obvious relevance for clinical practice. Thirdly, what we can learn about the emotional stages of childhood may contribute further to our understanding the factors involved in mental health at all ages. Fourthly, and in line with the second half of Rousseau's quotation, knowledge about the way children's minds work permits us to deal with children appropriately. Perhaps the most modest of these four aims, it may yet prove to be the most significant.

Let us consider each in more detail:

Pure research. The field of psychology has always given rise to the most intense controversy and schism, possibly because the science is a young one and established knowledge meagre. It would not, however, be expected perhaps that opinions would differ radically about what it is we are attempting to study when we speak of the emotional development of the child. Yet that is, or has been, very much the case. At one extreme is the approach of Watson and his followers of the Behaviourist School who declared that human behaviour could be explained without reference to 'personality' or anything else which is unsubstantial. Freud, in contrast, was primarily concerned with revealing the invisible and irrational forces in personality. At the present time we have reached a stage of gradual if grudging mutual respect and acknowledgement that each has much of value to offer.

Research cannot proceed without its appropriate methodology, and here there are immense difficulties especially in early childhood studies. It is easy to take refuge in the fact that the infant cannot communicate to the observer feelings, thoughts, or attitudes so that there is a constant danger of making subjective interpretations, but not so easy to explain why until recently there have been practically no systematic studies of, for example, the behaviour of infants. Developments in this field are available to the reader in 'Determinants of Infant Behaviour' (Foss, 1961; 1963). One pioneer endeavour is worthy of special mention, namely 'The Nursing Couple' (1941) in which Middlemore studied the breastfeeding situation and took the first step in differentiating some main varieties of infant activity *as part of an interactive process*. There are still very few studies of the reciprocal interaction (diadic behaviour) of mother and baby or indeed of parents and children of any age.

Another considerable methodological landmark was the recognition that observational data were constantly available in the *spontaneous play* of children. While this has become an accepted method in clinical child psychiatric practice both for diagnostic and therapeutic purposes, here also there are few research studies comparable in diligence of observation with the pioneer work of Susan Isaacs (1933). It is true that her interpretations of the children's words and actions in a nursery school setting were in line with the theoretical postulates of Melanie Klein, but the data are there, recorded and observed, and available for study and re-evaluation by successive generations of students.

The psycho-analysts, Freud included, have often maintained that every analysis itself constitutes a research project and in the sense of 'clinical research' this is a reasonable claim. As a procedure for eliciting psychological data about childhood it is subject to all the imperfections of a retrospective technique, including the patient's ability to recall. In fact this method has clearly demonstrated that there are laws concerning the retention and loss of childhood memories (*infantile amnesia*). An interesting modification which has been applied in recent years is the simultaneous psychoanalysis of mother and child which is beginning to reveal parallels in the thought processes of each, though refuting a simple cause and effect relationship (Burlingham, 1955; Hellman, 1960).

The work of Piaget is a unique contribution to our understanding of children's thought processes. His critics have rightly observed that the subjects he has studied are (*a*) few in number; (*b*) his own children; and (*c*) without controls. It must be acknowledged, however, that with great originality, especially in the design of experiments, he has revealed probable mechanisms and sequences of thought according to stages of development which others are now testing with all the necessary safeguards of controlled research. Piaget's concern is primarily with the sequence of development and not with age norms. Reference to his work may be found also in Chapter 8 ('Behaviour Development') for which it has considerable relevance, but here we shall consider some of its implications for child psychology and psychiatry as discussed recently by Woodward (1965). Piaget's approach serves to bridge the intellectual and emotional aspects of child development which have tended in the past to be treated separately. A few examples will serve to show the importance of his findings for certain theories of psychological development. For example, he states that the infant's inner world and reactions are bound by perceived objects and hence by the immediate present; memory images do not develop until halfway through the second year, nor does the capacity to represent one object symbolically by another. These findings are at variance with theories which attribute to the infant a capacity for recall. Again, although the two-year-old shows some capacity for the recall of past events in action and play the child has not yet the necessary verbal structure for understanding a promise. Before the age of about eleven years concreteness in thinking may be expected. The richness of Piaget's work is matched only by the complexity of his terminology and it is already obvious that time will have to elapse before the full implications of his contribution are grasped.

If the methodological techniques so far discussed are disconcerting to those accustomed to the research methods of the physical sciences this is not necessarily a defect but rather a recognition that this particular field of study has unique features demanding its own methods of investigation.

Ethology, the study of animal behaviour, has developed rapidly as a research discipline in recent years, and already its findings are providing fresh slants on human behaviour. Tinbergen (1951) has paid particular attention to what is termed the *Innate Releasing Mechanism*, a species-specific response to a particular stimulus.

Imprinting is a particular type of innate releasing mechanism whose function is closely linked with a particular type of conditioning (Lorenz, 1956).

In a now famous experiment Lorenz has demonstrated that the newly-hatched greylag gosling responds to the movement and noise of its mother by following her, but will develop the *following response* to any object between the sizes of a bantam hen and a rowing-boat which moves and emits noises of varying pitch. In many different species it has now been demonstrated that certain types of useful biological learning occur most easily at particular ages, and it is likely that such *sensitive periods* remain to be charted in human development.

Establishment of norms. It is tempting to believe that what Gesell has done for psychomotor development, namely establishing age norms from birth to adolescence, demands only comparable enthusiasm and industry to make available analogous standards of emotional maturation. One basic aspect of human emotional development invalidates this belief: the tremendous variation from one individual to another at all stages of emotional growth. Indeed age is only one, and not necessarily the dominant, of several major variables such as sex, social class, historical and cultural setting. This might appear to be a baffling situation when attempting to assess an individual child at a given moment in time, but is in fact not so very different from the difficulties involved in estimating physical growth. In both instances a single set of observations has little value whereas one in a longitudinal growth series, even if relatively short, can be revealing. Admittedly units of height, weight and so forth are reassuringly concrete compared with the intangibles of feeling, attitude, thought and behaviour, but these are the relevant data and we must learn to use them. *Moreover it is likely that instead of pursuing normative values we must learn to recognise characteristic sequences.* Even allowing for the many variables mentioned the human organism does seem to have a unique sequence of unfolding. This is very much in keeping with the approach of Piaget. It is also inherent in psychoanalytic theories of personality growth.

For a presentation of the psychoanalytic view refreshingly down-to-earth in its concern with the practical problems of clinical assessment the reader is referred to a recent monograph by Anna Freud (1963). Here she develops the concept of 'Developmental Lines' and details the sequence of events in a number of these: (*a*) Dependency to emotional self-reliance, (*b*) towards body independence, (*c*) egocentricity to companionship. Particularly pertinent are the concluding observations about correspondence between different lines of development in a particular child. She points out that in practice we expect a fairly close correspondence so that to be a healthy personality a child who has reached a specific stage in one line will have made a corresponding achievement in another. Yet it is recognised that many children show a very irregular pattern, *e.g.* with high achievement as regards bodily independence such as sphincter control while lagging behind in play-level and vice versa. It is suggested that our task is not to isolate two such lines or aspects of development but to trace their interaction giving special consideration to what is determined by innate, and what by environmental factors.

This is a convenient point to add that even if we are some way from resolving this duality, it is at least apparent that the former mutually exclusive attitude to personality development, the heredity–environment controversy, is meaningless. That being so, in a sense the approaches of Gessel, Piaget and the psychoanalytic school are all too exclusively child-oriented. Each acknowledges the importance but does not record environmental data. A reciprocal pattern of behaviour between mother and child unfolds from birth onwards, possibly earlier, and this is often implicitly recognised in clinical practice. In all cultures and social classes mothers and babies 'play games' such as 'peek-bo'' and 'this little piggy' which almost certainly correspond to stages which the child is just about to reach (see later reference to 'body image'). The mother, it seems, is responding intuitively to minimal cues, but neither these nor the infant's response, nor the maternal reaction to the response have been studied systematically. We lack a map of developing inter-personal relationships.

Implications for later life. Irrespective of theoretical orientation there are few who would now deny the importance of childhood experiences in shaping the adult personality both with regard to (*a*) *character formation*, and (*b*) *mental stability*. Differences arise, however, as soon as we consider how these factors operate. Eysenk and Rachman (1965) postulate two inter-related inherited tendencies obtained by subjecting to factor-analysis the 'neurotic traits' of large numbers of children. These traits are found to correlate together thus defining (1) a factor of 'neuroticism' (instability), and cutting across this (2) a second factor which divides conduct problems from personality problems, and which is designated 'introversion–extraversion'. The 'introverted, neurotic' child is characterised by personality problems such as a tendency to be depressed, seclusive, absent-minded, irritable, to have day-dreams, inferiority feelings, mood swings and mental conflict. The 'extraverted neurotic' child on the other hand tends to have conduct problems, to be ego-centric, rude, violent, disobedient and destructive and is given to fighting, stealing and truanting. It is claimed that this division applies to girls as well as boys and at varying ages. Evidence is presented suggesting that underlying the 'neurotisism' is an inherent pre-disposition of the autonomic nervous system to react strongly and lastingly to stimuli; whereas the introversion–extraversion tendency depends on the speed and strength with which conditioned responses are formed. Individuals who condition quickly tend to develop introversion personality problems. Symptoms are explained as maladaptation or inappropriate conditioning, and logically, conditioning techniques are used in what is termed 'behaviour' therapy. For those to whom the essence of the human being is the 'inner world' the capacity for self-awareness, for reflection and imagination, the behaviourist approach must inevitably seem incomplete, almost irrelevant, in spite of its insistence on objective observation.

Much controversy surrounds the problem of *how* childhood experiences affect later personality. No less important is the task of identifying *which* particular factors operate siginficantly. The one about which considerable evidence has accumulated is that of *social deprivation*. For a full review of this subject the reader is referred to Bowlby's classic monograph (1952) and to the *World Health Organization Bulletin* No. 14 (1962). Here we shall deal with a few main landmarks. Spitz (1945) was among the first to draw attention to the fact that human infants if not given sufficient mothering, even though nutritional and hygienic standards are adequate, tend to become withdrawn, listless, apathetic, to succumb readily to acute respiratory or gastro-intestinal infections and often die. This clinical picture he called 'anaclitic depression', and Bakwin (1942) described its appearance in babies kept in hospital for long periods. There was no information about the children who survived, but other workers such as Goldfarb (1943) following the development of children reared for long periods in institutions began to recognise a typical personality picture which Bowlby termed the 'affectionless character' and which resembled in many respects what we understand by the adult 'psychopathic personality', namely gross impairment in the capacity for human relationships combined with a defective sense of conscience. This aetiological hypothesis not surprisingly has been unpopular with child-care personnel and with many paediatricians but if the case was originally overstated it certainly helped to foster a more consciously humane attitude in the professional handling of young children and especially as regards the rights of their parents. The main facts, however, cannot be side-stepped. From clinical studies there is growing evidence that early bereavement, related to social deprivation, is a highly significant factor in a later tendency to depression, especially suicide (Brown, 1961), as well as to delinquent and psychopathic personality (Gregory, 1958).

Supportive evidence regarding the importance of emotional deprivation has recently come from an unexpected quarter, that of animal behaviour. Harlow (1962), working at the Primate Laboratory, University of Wisconsin, has studied the behaviour of monkeys reared under differing, carefully controlled environmental conditions. Monkeys reared in isolation developed peculiar patterns of behaviour. They sat and stared vacantly, circled repetitively, rocked, chewed and pinched themselves, especially at the approach of a human. Six month's isolation made these effects permanent.

Curiously the presence of an inanimate, soft, warm 'dummy' mother prevented these disturbances from developing in severe form. Intimate body contact appeared to be the primary mechanism. The maternal relationship was significant in facilitating the interaction of the infant with other infants, and, surprisingly, opportunities for optimal interaction of the infants with other infants appeared to compensate for the lack of mothering, at least as far as later social and heterosexual relations are concerned.

No less remarkable are the experiments on partial social deprivation: 100 monkeys of each sex were reared in cages where they could see and hear other monkeys but could not play with them during the first six to twelve months of life when they normally learn to play with each other. None of these male monkeys so reared has ever made an adequate sexual adjustment to any female monkey. Half of the female monkeys did, after a time, respond sexually to normal males and some did conceive. When in due course these socially deprived females became mothers without exception they failed to feed their babies, and in fact abused them. The offspring, moreover, displayed precocious sexual behaviour.

While caution is necessary in applying experimental findings on monkeys to the life situations of human beings nonetheless these results tend to reinforce hypotheses about the pathogenicity of early emotional deprivation. Particularly impressive is the evidence for a connecting link between one generation and the next.

This type of deprivation is but one form of early childhood experience. Others, such as parental attitudes, now await accurate definition and prospective study.

The understanding of children. At first glance this is the least ambitious of our goals—to study the emotional development of children in order to understand them. Yet in many ways it is the most challenging. We have seen that the experiences of children from infancy onwards can effect their wellbeing, even their physical health, that these events may have an important bearing on their future emotional lives. There is, however, a danger of setting our sights at too long a range and ignoring the present, of making children insecure or unhappy or afraid not intentionally nor neglectfully but from ignorance or unwillingness to recognise the evidence before us. It is fairly certain that satisfying experiences in childhood do strengthen personality resources later on but there is also a humanitarian aspect in that one should through understanding attempt to make the lives of young people happy. Understanding the ways and methods of communication of children has also important pedagogical significance in that it can help us to use appropriate educational techniques at different age levels, not merely in the sense of formal instruction but of imparting cultural values.

Stages of Emotional Development

Infancy. The life of a young infant may be considered as a constantly repeated cycle of events—much sleeping or near-sleeping and less wakefulness during which occurs feeding, eliminating and crying. The infant cannot say what it feels, for example, when its stomach is empty or its surface temperature has fallen or its posture is suddenly changed, but presumably these are situations of unease. In contrast the drowsy, cooing and babbling after a feed when clothes are warm and dry, when sensations in general in fact are pleasurable seems to represent the earliest stages of contentment, of enjoyment in just existing. There are many imponderables here but none more curious than the paradox that this creature who is entirely dependent on the mother (or her substitute) for physical survival is yet very frequently in almost complete command of the adult. While fashions change as to whether crying babies should be lifted or left (both extremes are probably ill-advised) it is not difficult to imagine that the dawning mind is becoming aware of the power of its own cry. While child development is often seen as a gradual transition from dependence to independence (or more correctly from relatively more to relatively less dependence) it is equally important to recognise the renunciation of the omnipotent attitude of the infant. Whereas some adults never achieve much independence at all others remain imperious and demanding throughout their lives. Nearly every child during the second or third year has to live through the painful experience of this renunciation which contributes to the typical negativistic behaviour of a toddler.

Psychoanalytic theory lays great emphasis on the dominance of the mouth in infancy, that is to say as a zone of pleasurable stimulus. It is also at this early stage a principal touch organ, its use for the tactile examination of objects preceding that of the fingers. Thus the lips suck and touch, the tongue tastes and feels, the gums bite and chew—a wide range of sensations are centred in the mouth, during this so-called *oral phase*. In consideration of the most primitive levels of sense-organ activity disproportionate emphasis has almost certainly been placed on the mouth at the expense of the tactile sensibility of the skin surface and of stimuli from the kinesthetic and vestibular systems (see Erikson, 1958). Displeasure also tends to be displayed orally in screaming, biting or spitting but here again there are wide physical concomitants in violent contractions of skeletal muscle. If the adult personality shows the characteristically infantile traits of extreme dependency combined with imperious demands this person has in psychoanalytic terms an 'oral character'. This is an extreme form of immaturity, emotional development having, as it were, been held up or 'fixated' at this stage either because of grossly inadequate nursing or because of a sudden disruption of a satisfying nursing experience. The terminology here does not serve well the quite profound considerations which it is intended to imply. Immaturity of this degree may indeed represent failure to emerge from this very early stage, but the fixation is one not of an aspect of body-erotism only but of the whole circumstances of interdependence with other people which, appropriate to that early stage, have persisted without necessary modifications into adult life.

The development of the earliest attachment to the mother ('object relations') is regarded by Bowlby (1960) in a radically different way from that of traditional psychoanalytic theory. On the basis of the ethological concepts of instinctual response systems mentioned earlier Bowlby suggested that the infant's attachment to the mother is a basic component in this earliest reciprocal social relationship and is not secondarily derived from the satisfactions of food and warmth. Clinging, it is postulated, is as fundamental a response as sucking. This is a challenging hypothesis with important theoretical implications regarding the origins of anxiety and depression.

Now let us consider the mother's role in this earliest of human relationships. It is convenient to see in her activities a spontaneously (*a*) affectionate, and (*b*) protective attitude. This rather artificial division is useful as we see distortions of each clinically, for example, maternal rejection or ambivalence, 'maternal over-protection' (Levy, 1943). It is much easier to talk about disturbances in mother–infant behaviour than to make any dogmatic statements about what is normal. There is in fact little definite evidence about the long-term sequelae of disorders of mothering but certainly at the time the infant may react with unusual patterns of crying (either too much or too little), of feeding (apathy, vomiting, rumination), breath holding, head rolling, and so on. The infant nursed in tense arms often screams, loses interest and may vomit but rapidly settles to contented sucking when transferred to experienced hands. The rocking chair, the crib, and the lullaby have evolved empirically no doubt because they aid the relaxation of both parties. There is much evidence then that infants require in addition to nourishment and protection, frequent gentle confident handling by a familiar person.

Babies respond to a smile with a smile by the second month (Ambrose, 1961) but this is not necessarily an indication that they as yet recognise people. By six to eight months however the child already reacts to separation from the mother with the characteristic sequence of distress, rage, apathy and grief of the older child (Schaffer, 1958). This stage would appear to represent a crucial 'milestone' in the development of interpersonal relations, the beginnings of attachment specifically to the mother. As Schaffer himself has pointed out there is a danger of this finding being misinterpreted to mean that separation of younger babies from their mothers carries no danger psychologically. In fact, however, there is abundant clinical evidence that the initial 'coupling' process between mother and infant may be disrupted when delayed, for example after a premature birth where the child requires to remain in hospital. It is probable that the father is recognised also long before the first birthday. There is a curious absence of systematic enquiry into any aspect of the father's role in relation to his developing child.

INFANT MANAGEMENT AND MENTAL HEALTH. It is now relevant to consider to what extent particular child-rearing practices affect the emotional development of the individual. It has to be acknowledged that there is little solid foundation for the important role in character formation and adult mental health that has been ascribed at various times to, for example, artificial feeding, swaddling, early or sudden weaning, too much or too little lifting and cuddling, and closely related to this, leaving babies to cry; too rigidly organised feeding schedules, toilet training in the first weeks of life, permitting the use of soothers; to the frequent use of laxatives, enemas and suppositories. These are matters on which the advice of the physician in family, welfare clinics, and paediatric practice is commonly sought and unfortunately there is no trustworthy book of rules, and there probably never will be. This does not mean that all or any of these practices are unimportant; each and every one has demonstrably acted as a traumatic experience for an individual as revealed in the course of exploratory psychotherapy. This, however, is a complex matter because of the tremendous variation from child to child. Innate factors do exist even if we know little about them and, for example, one infant may be comfortable only with a well-ordered feeding régime, a second on a self-demand schedule, a third able to accept either, and a fourth a 'difficult feeder' no matter what is tried. This last baby may, of course, be 'difficult' no matter how skilled and relaxed is the nursing person, or may be responding to the insecure, inconsistent handling of a very nervous mother so that the precise feeding schedule is a relatively minor consideration. This is the second consideration, that it may well be true if unproven as yet that in every example mentioned associated factors, and especially relationship factors are paramount. Where for example in the aetiology of a neurosis inappropriate use of enemata to a young child is relevant it may not be the practice itself that has contributed as much as the 'emotional climate' of the transaction, whether for example the manipulation of the child had a sadistic or other erotically-toned component. When considering the importance of weaning, Bowlby (1960) pungently comments that 'a mother is more than a pair of breasts' thereby high-lighting the too often neglected concomitant experience of the child at this time, such as the birth of a sibling or separation from the mother.

It appears then that within very wide limits all sorts of infant-rearing methods can be employed without detriment to the child's emotional development *provided the mother is oriented to the needs of the child*. Thus her technique may not be identical with all her children. In response to tangible cues from her children she may do things differently or the same things at different stages.

Where in contrast a mother—and at a slightly later age this begins to apply with equal force to father—is in child-rearing activities responding primarily to her own inner needs, then we are in the realms of maternal psychopathology. We may be confronted with a psycho-neurosis or acute psychosis in the mother which involves her child and for which treatment is required; a disorder of the mother–child relationship where the mother's personality is basically a sound one, in which the disorder is often 'triggered' by events during this or a previous pregnancy, at the time of delivery or just after, and where psychotherapeutic intervention is often quickly effective; or where the disturbed mothering is but one facet of a profoundly disordered personality in the mother such as a 'character disorder' which is unlikely to be modified by any treatment procedure, and where therefore the professional helper must be content to give support, encouragement, and direct advice on child management.

From this brief survey of the psychopathology of mothering it follows that imparting information is but one aspect of *parent education*, and not always the most important. What the majority of parents want is guidance on how to act in specific situations, and they are often helped in this by group discussions with other parents. The frequent gain in understanding and self-confidence is however not merely from the acquisition of facts, but from sharing their anxieties with others, meeting approval in the process from the other parents and the group leader. An invariable task of parent education is the modification of culturally-determined attitudes and practices. These may be inappropriate in the sense that they do not tally with the facts of child emotional development. Many parents for example are still shocked to find their infant explore its genitalia and orifices, to witness an erection in a male baby, especially during feeding, or observe masturbatory movements of young children of both sexes. It is a relief to them to hear that these are common and harmless activities. Many are surprised that disgust is culturally determined and that there is no cause for alarm when a baby plays with its own excreta.

By all means let us give accurate child developmental information to parents so long as we recognise that there are other aspects than didactic teaching.

Early childhood. As soon as the child begins to walk the beginnings of striving for independence are seen, at first fluctuating with frequent retreats to the safety of the parent's arms. Separation for any length of time as we have seen causes intense distress. With the development of speech the main channel of communication is established and we as observers have our first real access to the child's thoughts and feelings. Long before 'make believe' play is reached early forms of phantasy take shape. Objects are credited with living, human attributes (*animistic thinking*) so that, for example, a hurtful bang on the head leads to reprisals against 'the bad table'. It has been suggested that familiarity with all external objects is achieved in the first instance by seeing in them aspects of the child's own body. Moreover, there is a magical quality in early thinking in the sense that thoughts alone can shape events, and when we consider the intensity of a young child's loving as well as hating these events may be alarming. *Animism* and *thought omnipotence* may return during adult mental illness, and are seen also in primitive societies. In the minds of young children phantasy and reality merge. Childhood thought, as Rousseau sensed, has its own logic which we now begin to comprehend as these mental mechanisms are recognised. Much of the behaviour at these early stages can be seen as the drive to discover new things and experiences and the mastery of the anxieties aroused. This results in frequent flight to what is familiar, and sometimes the deliberate manufacture of what is familiar as in bedtime and other *rituals*. The teddy-bear serves many purposes: when the child is alone as an imaginary companion or something to cuddle in place of mother; as a scapegoat; as a pretended companion to praise or blame, love or reject, as inner needs dictate. On this particular topic the writer A. A. Milne is probably still the most perceptive observer.*

Some children, however, prefer a piece of blanket or fringed material from which they may be inseparable for years, more especially at bedtime or when feeling ill or insecure, and to which they give a special private name. Winnicot (1958), has described this as a 'transitional object'. This he regards as the child's first real possession, an intermediary perhaps between a thumb and a doll. Children are greatly comforted by being allowed to take with them not just toys but especially familiar objects when they go to hospital or other strange places. When the toddler returns again to the security of its own home he may begin wetting or soiling (or these may have appeared during separation and persist for a time), demanding to be fed, refusing to sleep alone or even be separated during the day, may return to baby-talk, and begin thumb sucking. All this behaviour is a typical response to a situation of fear and or insecurity which is or has just been experienced, and represents a *regression* to an earlier emotional level. This can occur in human beings (and probably animals too) at all stages of life though adults hide it better, and bodily functions are not so obviously affected. Regression serves as a safeguard and is almost always temporary. Parents can be greatly helped by being warned in advance about its likely occurrence, and the importance of responding appropriately to the child's temporary infantile needs. Another common situation which may lead to regressive behaviour is the birth of a baby brother or sister. Once parents have grasped the reality and intensity of the toddler's feelings of rivalry, jealousy, love and hate they usually have the initiative to deal effectively with the situation. The child acquires socially commendable attitudes but slowly, and there should therefore be no shock at hearing the imperious demand to 'send the baby back'. Fortunately dolls and teddies are there to take some of the brunt of this intense ambivalence.

Irrational fears of specific things often develop in the early years, fears of flies, dogs, horses—the so-called *phobias*. The dangerous impulses which the child ascribes to these creatures is regarded as a measure of the intensity of feeling being experienced within the child (*projection*).

Toilet training has important psychological components. Besides the earlier curiosity and exploration, faeces and to a less extent urine is at various stages regarded with pride and often fear. There is evidence that in neuro-physiological terms conscious sphincter control is not possible till about one year old. The mother who is pleased at 'never having had a dirty napkin' often mistakes her accurate timing of the child's gastro-colic reflex with early mastery of bowel evacuation. When this does become functionally possible the child often refuses to perform on request, and may seem deliberately to 'hold back'. When accidents are ignored and successful defaecation rewarded regular bowel habits usually form fairly easily; but if much fuss and temper is aroused in the parent a common sequel is 'constipation'. This is often explained as the result of a painful anal fissure but this is more often a result than a cause. Intense parental preoccupation with cleanliness may also inhibit the child's early bowel functioning.

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* 'Now We Are Six'; 'Winnie The Pooh'. A. A. Milne. London: Methuen.

Quite small children often seem to locate accurately the sensitive areas in their parent's make-up, thus providing themselves with retaliatory weapons. For example, towards a mother who is really upset by a child's misbehaving in company, this is clearly a way to punish her; if anorexia makes her distraught as often as not this is the form a behaviour disorder takes, and so on. The acts of defaecation and urination represent aggressive impulses as evidence by the slang connotation of these terms in our vocabulary. In order to conform with the mores of society represented by the parents' approval pleasurable interest is converted to disgust (*reaction formation*). Sometimes this transition is exaggerated to one of inhibition of all assertiveness making the child passive, conforming, and lacking in initiative. Quite often this is associated with both oral inhibition such as speech hesitancy as well as bowel inhibition leading to constipation and encopresis. The wish to indulge in messy play may also be displaced to a 'safer' area so that toddlers often play messily with their food and as this is transient and usually does not interfere with nutrition as such it is best tolerated. Ultimately these impulses are sublimated to socially-approved goals such as sand and water play, clay and plasticine, modelling or painting. Psychoanalytic theory holds that this phase of development is the origin of certain 'anal' character traits such as meanness, excessive preoccupation with orderliness and precision.

Real interest in co-operative activity with other children seldom begins before two and a half to three years so that organised group activities in nurseries or elsewhere before that age usually fail. Ego-centricity, ruthless possessiveness, and uncontrolled aggression gradually respond to socialising influences, partly because of the fear of punishment but more importantly from the fear of losing the parent's love. This is how conscience is formed on the basis of the one real parental sanction. It is not difficult to see therefore how closely interwoven are the strands of love and conscience.

If certain questions and situations tend to produce an anxiety-laden response from the parents which the child identifies in the pitch of the voice, evasive tactics, inappropriate anger or laughter and so on, then curiosity is inevitably sharpened and there is a tendency to indulge in speculative phantasy. The anatomical differences in sex may be accepted readily, or become a source of confusion and anxiety, largely depending on family attitudes; the same is true of the facts of reproduction, birth and death. The manner in which such questions are answered is every bit as important as the answers themselves.

Between about four and eight years there is often intense fear of anything which could possibly lead to bodily mutilation, or injury, and especially in boys anxiety about loss of limbs, fingers or toes, or the penis itself (*castration anxiety*).

This underlies the occasional terror at any surgical procedure in the lower part of the body—not only when masturbation is countered by the threat 'to cut it off'. A related anxiety is the common fear of the hair being cut.

All such fears are commoner in boys than in girls, and have been attributed by Freud (1908) to the imagined retaliation of the father as a result of the boy's erotic stirrings towards his mother. This classical 'oedipus complex' is probably by no means a universal phenomenon though with the associated castration complex it does seem aetiologically important in hysterical conditions in both sexes.

Whether the sexual component is accepted or not there is no doubt about the intense attachment of most small girls to their fathers, small boys to their mothers, and ensuing rivalry with the parent of their own sex. Herein lies the prototype of later 'triangular' situations. If the possessive child is tolerated and perhaps humoured, reconciliation is slowly achieved. Rejection or eroticised play on the parents' part, usually unconsciously determined, may lead later to psychomatic problems.

Later childhood—the emergence of a person. Mind is an abstraction. In describing its development it is therefore necessary to use abstract concepts. Among the most fundamental of these are the awareness of oneself, essentially of one's own body; a gradually acquired awareness of constancy, compounded of all sensory experience, within and without the body. The awareness of its parts, of their relative proportion is really a neuro-psychological concept, *the body image*. The somewhat analogous but more complex concept is that of the *ego*, the part of the mind which perceives, thinks, remembers, registers the outside world, and which is conceptualised as having a boundary which delineates 'the self' from the 'non-self'. It is useful to the neurologist to regard certain subjective phenomena of his patients as distortions of the body-image; some of the bizarre experiences of a schizophrenic are comprehensible to the psychiatrist as defects of the ego-boundary.

Ego development probably begins in a rudimentary fashion at or before birth and may be dependent upon the integrity of the central nervous system and especially an intact perceptual apparatus. Given this organic matrix, from the start we recognise as inter-dependent and interacting factors the built-in biological drives and the life experiences out of which personality is forged. The sense of *identity*, of being oneself a unique individual is central to any concept of a person, but we know little of how identity formation is achieved. The resolution of this process in adolescence when the course of personality development is finally set has been extensively studied by Erikson (1950).

However, long before a child goes to school one important facet of personality will ordinarily have arrived, namely a *sexual identity* the feeling of being male or female. At the present time the medical psychological aspects of the subject are clouded in complexity for 'male–female' has now three possible meanings at least (i) the form of the genitalia and secondary sexual characteristics; (ii) the chromosome appearances; and (iii) the subjective feelings of the individual. With recent advances in the study of inter-sex it was confidently anticipated that personality studies would reveal a link between somatic and psychological sex. But the evidence so far though not final by any means strongly suggests that an individual feels male or female because of the attitudes of others from an early age rather than because of any particular hormonal effect. Though the aetiology of homosexuality remains doubtful at least one carefully controlled study of males suggests a specific pathogenic family constellation, an assertive mother dominating a detached father who she denigrates to her intensely loved son (Bieber, 1962). Whatever the precise pathogenic influence many psychiatrists and psychoanalysts incriminate disturbed mother–son and father–daughter relationships.

While it is well known that transient homosexual attachments are common in adolescence and usually need cause little concern, it is often a surprise to parents when young children show marked preference for the toys and activities of the opposite sex. We are more tolerant of little girls who wish to be 'tomboys' than to little boys who show a sudden interest in prams and dolls, but neither tends to be a lasting predilection.

This aspect of the child's identification is greatly facilitated when both parents are uncomplicated in their sexual roles. In a one-parent family the child will usually seek out another relative or friend as a substitute.

This is but one of the many roles which grandparents may fill to the child's advantage. When we consider that a child psychiatric clinical study almost invariably involves three generations it is remarkable how little research has been focussed on the role of grandparents. It is a unique relationship with its frequent blend of affection and permissiveness. It affords to the child a sense of continuity, of 'roots' and of belonging.

Certain games are played with such frequency and enthusiasm by young children that they deserve a word of special mention. 'Playing at houses' which usually involves a wedding and offspring with many variations serves to foster identification with a parent of the same sex, to seek answers to questions about reproduction and to master fears of their own parents by acting the parts of the awesome fathers and mothers. Whenever a person or an animal is particularly feared the child tends to play this part in fantasy and to repeat this over and over again. Many a child has played at 'being the dentist', but never the patient—at least voluntarily. 'Playing at doctors' serves the same end as well as the exploration of sexual differences. This is also one of many ways in which the problem of death can begin to be tackled. Children are seldom morbid about this but intensely interested. Most questions—and at this stage they are endless—should be answered with as much of the truth as is appropriate to the child's age and comprehension.

By the time the child goes to school emotional maturation is seen in the gradually acquired toleration of frustration, increasing control of motility, ability to concentrate on tasks set by another, and an acceptance of limits. Given reasonable ability and compatibility of temperament between pupil and teacher information is acquired rapidly whereas awareness of inner instinctual drives has become negligible.

With the first stirrings of puberty the emotionally quiet period is at an end and both feelings and behaviour enter a phase of new turmoil.

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Chapter 10

INFECTION AND IMMUNITY

During the past century there has been a steady and most remarkable decrease in deaths from infection, and children, particularly those under five years of age, have been the principal beneficiaries. Deaths among children (0–15 years) from the four main infectious diseases (scarlet-fever, diphtheria, measles and whooping-cough) have fallen from rates ranging from 1,250 per million (measles) to 2,500 per million (scarlet-fever) in the decade 1850–60 to negligible proportions in recent years. Nonetheless, infection is still the most important contributor to illness among children. For example, in the Thousand Families Study in Newcastle (Miller *et al.* 1960), there were 8,467 significant incidents of illness among 847 children in their first five years of life (1947–52); of those, 6,845 (80 per cent) were infective conditions and 1,622 (20 per cent) were non-infective illnesses such as accidents, allergic rashes, surgical operations, squints or speech disorders. Of the infections, more than half were respiratory infections (colds, sore throats, febrile catarrhs, bronchitis, etc.), rather more than one fifth were due to the specific fevers (measles, whooping-cough, chickenpox, mumps, etc.), and about one tenth were alimentary infections. Thus these three groups of infections were responsible for 87 per cent of all infective illnesses and 70 per cent of total illness. The only other groups numerically important were staphylococcal infections which contributed 5 per cent and pyrexias of unknown origin causing 3 per cent of the illnesses (see Table 15).

Table 15

Distribution of 6,845 Incidents of Infective Illness in 847 Children in Five Years

Newcastle-upon-Tyne, 1947–52

Respiratory infections	3,755	Staphylococcal infections	341
Whooping-cough	392	Acute infections of unknown origin	221
Measles	540	Herpetic stomatitis	118
Chicken-pox and zoster	240	Conjunctivitis	79
Rubella	134	Tuberculous infection	61
Mumps	113	Infective hepatitis	24
Alimentary infection	793		

The impact of these various infections on the physical and mental development of the young child may be considerable. Colds, catarrhs and measles predispose to otitis media and bronchitis; chronic otitis media may cause partial deafness which in turn may retard learning at school; whooping-cough may lead to pneumonia and bronchiectasis and, some believe, to mental retardation; measles and mumps may be followed by encephalitis. The risks of infection are increased by poverty and overcrowding and the various social and environmental factors associated with them: for example, deaths from the pneumonias of early childhood still have a sharply rising social gradient from Class I to Class V, while acute respiratory infections and streptococcal sore throats are commonest in overcrowded communities. Improvements in the nutrition, housing and way of life of the economically poorer classes will continue to be a very important factor in reducing the amount and severity of infection in a community. More specific measures to protect susceptible children will be further discussed here. These measures consist, in the main, of attempts to give the child a specific resistance or immunity against infectious diseases like smallpox, diphtheria, poliomyelitis, whooping-cough, measles and tuberculosis. Little effort has as yet been made to provide protection against the great mass of acute respiratory infections but the steady progress now being made in the identification of respiratory viruses associated with such clinical syndromes as the common cold, croup, febrile catarrh, influenza and the non-bacterial pneumonias gives promise of future success. Again, no specific prophylaxis is available for the hotch-potch of alimentary infections although special control measures (*e.g.* chemoprophylaxis and chemotherapy) may be effective in particular circumstances as is also the case with the acute pyogenic infections.

Acquired Immunity

The term immunity is often used elastically to cover any biological mechanism that gives the body protection or resistance against infection. The physico-chemical barriers of healthy intact skin and mucous membranes with their associated secretions—the unsaturated fatty acids of the skin, the hydrochloric acid of the stomach, the lactic acid of the vagina, the lysozyme of tears and mucous secretions—give the body what is sometimes called natural immunity but which more properly is a non-specific resistance to infection. Similarly, the body's capacity to deal with invading pathogens in the early stages of infection—the phenomena of inflammation, localisation and phagocytosis—exemplifies a physiological and non-specific resistance that should not be equated with immunity. Immunity is an acquired resistance to infection, which develops during the course of a clinical or inapparent infection or can be induced artificially by the injection of ready-made immune substances (antibodies) or of an innocuous suspension of the pathogen or some metabolite or fraction of it (antigens). This immunity is specific for the particular pathogen causing the infection or used artificially as antigen; for instance, a child who has had measles is unlikely to have a second attack but is not thereby protected against whooping-cough.

Immunity may be acquired naturally or artificially; and both forms of immunity may be acquired either actively, that is the antibodies are produced by the host's tissues, or passively, that is the antibodies are supplied to the host ready made. An attack of measles gives immunity to further attacks and this is naturally-acquired active immunity. Most infants are immune to measles for the first four to six months of life, owing to the 'placental' transfer of antibodies from mother to foetus; this is an example of naturally-acquired passive immunity. Troops on active service are given two or more injections of tetanus toxoid to protect them against the risk of tetanus; this is artificially-acquired active immunity. Civilians may be given a dose of tetanus antitoxin following injury, and this is an example of artificially-acquired passive immunity. Passive immunity, following the injection of an antitoxin, is rapid in onset, immediate if the antiserum is given intravenously and requiring only a few hours to reach adequate levels if given intramuscularly or subcutaneously; but it has a short duration of only a few weeks, since the antibody, being a foreign protein, is quickly eliminated by the body. On the other hand, antibody transmitted from mother to foetus is eliminated from the infant much more slowly, *e.g.* diptheria antitoxin has a half-life of approximately thirty days. In the older child and adult, however, the breakdown and disappearance of injected homologous antibody occurs at a faster rate.

The route by which antibody is transferred from mother to offspring depends on the animal species. In ruminants and pigs antibodies are concentrated in the colostrum and are ingested and absorbed from the gut when the calf or lamb gets its first milk by suckling or feeding. Absorption of undenatured antibody occurs only in the first twenty-four hours or so of life. With rodents and primates, it has usually been supposed that antibodies pass through the placenta from mother to foetus and the difference in the modes of transfer in ruminants and rodents has been attributed to the number of layers of tissue between maternal and foetal circulation—four or five in ruminants and pigs, one in rodents and primates. However, it has been shown that in certain animals with 'placental' transfer, *e.g.* rabbits and guinea-pigs, antibodies pass from the maternal circulation into the uterine lumen, whence they pass through the entodermal membrane of the yolk sac into the vitelline circulation. It is not known if this mode of transfer occurs in the human species but there is evidence of some selection and concentration of certain antibodies during transfer from mother to foetus. Thus, the titres of antitoxins and viral antibodies, *e.g.* diphtheria antitoxin, staphylococcal and streptococcal antihaemolysins and vaccinial antibodies, are often higher in cord blood than in maternal blood whereas some bacterial antibodies, isoagglutinis and sensitising 'reagins' are present in much lower concentration in infant than in maternal blood. These variations are important in determining the passive immunity of the infant to different infections and explain why most of the specific childhood fevers rarely occur in infants under four to six months of age. Whooping-cough is an exception, not because antibody cannot be transferred but probably because there is little or no protective antibody to transfer. The level of antibody transferable from mother to off-spring can be raised by antenatal immunisation of the mother and this procedure has been suggested for infections like tetanus and poliomyelitis.

In contrast to passive immunity, active immunity takes time to develop but persists for months or years and, once acquired, is capable of restoration when it has dropped to a low level. There is evidence that the capacity to produce antibody in response to certain antigenic stimuli, *e.g.* pertussis vaccine, is less well developed in the first few months of life than it is in the older infant. However, with potent antigens, *e.g.* tetanus toxoid, infants under three months of age respond as well as the older child and poor responses are usually due to the interfering effect of passively transferred antibodies, *e.g.* to diphtheria and poliomyelitis. Again, the failure of smallpox vaccination that may occur in the neonate is probably related to the presence of vaccinial antibody.

The Rationale of Immunisation

Before discussing the application of immunisation to the control of communicable disease, it may be useful to summarise some of the basic principles in order to clarify what immunisation may realistically be expected to achieve in different types of communicable disease. The objective of immunisation is to produce, without harm to the recipient, a degree of resistance as great as, or greater than, that which follows a clinical attack of the natural infection. With this objective in mind, those communicable or infectious diseases amenable to control by vaccination may be considered in four main groups: toxic; acute bacterial; chronic bacterial; and viral infections. In the first group, *e.g.* diphtheria and tetanus, the brunt of the infection is due to a specific poison or toxin which can be purified artificially, rendered harmless by treatment with formalin (= toxoid) and used as a very effective antigen or prophylactic. The potency of toxoid antigens can be measured and standardised with great accuracy, and the amount of antitoxin that is produced in the inoculated person gives a reliable indication of the degree of resistance to infection in that individual.

Among the acute bacterial infections there are two categories as far as immunisation procedures are concerned: (*a*) pyogenic infections (staphylococcal, streptococcal and pneumococcal) against which vaccines are largely ineffective, since there are many different antigenic types within the species, *e.g.* pneumococcus types 1, 2, 3, etc., so that an infection (or immunisation) with one type does not protect against infection with other types; (*b*) infections like whooping-cough, cholera, and plague, where there is one antigenic type or organism, so that a vaccine prepared with the infecting organism might be expected to give a reasonable degree of protection. However, these organisms contain many different antigenic components, of which probably only one or two are particularly concerned with the virulence of the organism. It is important to try to identify and to preserve these so-called 'protective antigens' in vaccine preparations.

Another difficulty is that in infections like whooping-cough and cholera, the infection affects predominantly the epithelial surfaces so that antibodies produced as a result of vaccination may not gain easy access to the site where the pathogen is producing the infection. For this and other reasons it was essential to test vaccines against whooping-cough and cholera in properly controlled field trials, so that objective assessment of their value could be obtained.

So far the assumption has been implicit that the production of a specific protecting antibody is the main requirement for effective immunisation, although it should be noted that immunity may persist long after such antibodies cease to be demonstrable, as in whooping-cough. When the 'continued fevers' or chronic bacterial infections are considered (*e.g.* typhoid, brucellosis, tuberculosis) it must be concluded from knowledge of the natural behaviour of these infections that the identifiable specific antibodies play little part in overcoming the infection. Thus, antibodies to the specific antigens of the typhoid and brucella bacteria are demonstrable in the blood of the patient within a week of onset of the illness, but the fever may go on for many weeks before clinical recovery. In addition, relapses in these continued fevers are not uncommon despite the presence of high concentrations of specific antibodies. In contrast to the acute bacterial infections, the infecting organisms in chronic infections are for the most part intracellular parasites, and it seems likely that what is called cellular immunity may be more important in overcoming the infection than the presence of humoral antibodies. It is probably for this reason that in tuberculosis and brucellosis a living attenuated vaccine is needed to produce immunity.

In the viral infections it is known that humoral antibodies are important but, again, cellular immunity also seems to be important in some diseases; thus, children with hypo- and agammaglobulinaemia can recover from infections like measles, chickenpox and mumps with an apparently good immunity but without detectable circulating antibody, whereas they rapidly succumb to acute bacterial or toxic infections. Such children can also be successfully vaccinated with smallpox vaccine and with BCG. These findings indicate that specific humoral antibodies are not essential for recovery from some virus diseases. On the other hand, immunity to certain virus infections seems to be equated with the presence of antibody; *e.g.*, human gamma globulin can be used prophylactically to prevent or modify measles and infectious hepatitis in those intimately exposed to the risk of infection; killed viral vaccines which stimulate the production of humoral antibody can give good protection against influenza and poliomyelitis.

Immune Response and Duration of Immunity

The newborn baby may contain in its blood antibodies to the agents of certain toxic, bacterial and viral infections according as the corresponding antibodies are present in the mother's blood. This passive immunity gives protection to the infant at a time when it is poorly equipped to produce specific antibodies, but it also interferes to a varying extent with the infant's capacity to respond to the stimulus of toxoids or vaccines in the early months of life. Killed poliomyelitis vaccines elicit poor or nil antibody responses when given to children under six months of age; on the other hand, this 'antibody interference' can to some extent be overcome by potent antigens. It should be noted that the newborn infant can be given protection following inoculation of live vaccines, *e.g.*, BCG and smallpox vaccines.

When a good specific antibody response is being sought to a toxoid or killed antigen, the usual procedure is to give two or three doses of the antigen at intervals of several weeks. The first dose of antigen evokes a poor antibody response after a latent period of approximately two weeks, but after the second dose the amount of antibody produced is multiplied tenfold and after a third dose may be increased a hundredfold. This first or 'priming' dose of toxoid will be more effective the larger it is; or if it is released slowly as from a mineral carrier*; or if it is mixed with certain bacterial vaccines, *e.g.* tetanus toxoid plus typhoid vaccine, diphtheria toxoid plus pertussis vaccine. The second and subsequent doses are effective in much smaller amounts than the first, and without the help of adjuvants. With toxoids the response is much better if the two doses are spaced out at an interval of four to eight weeks, and, provided the priming dose is adequate, the response to the second dose will still be maximal even if it is given some six months after the first. This enhanced response may not occur when killed bacterial or viral vaccines are being used. However, where there is reason to believe that a community has acquired a basic immunity from the widespread occurrence of clinical or inapparent infection, as in influenza, one dose of antigen will act as the secondary stimulus.

As regards the duration of immunity after the basic course, this can be measured precisely in the case of toxic infections according to the level of specific antitoxin in the blood, or, less precisely, in diphtheria by the Schick test. Recent studies have shown that an adequate concentration of diphtheria antitoxin may persist in the blood of children for three to four years after primary immunisation in early infancy. After a primary course of three doses of tetanus toxoid, a satisfactory antitoxin titre may be present for as long as ten years.

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* Mineral carriers, *e.g.* aluminium hydroxide or aluminium phosphate, are not now recommended in the U.K. because of the slight risk of post-inoculation poliomyelitis after injections of alum-containing prophylactics.

The duration of immunity after injections of killed bacterial vaccines cannot be equated with the presence of demonstrable antibody; for example, after a course of three doses of pertussis vaccine given to children (average age one year) there was no change in the degree of protection in successive six months during a follow-up period of two-and-a-half years, although antibodies were no longer demonstrable in a considerable proportion of the children within a year after immunisation. Again, in the chronic bacterial infections, there is no correlation between antibody titres and clinical protection, as was shown by a controlled trial of typhoid vaccines in Yugoslavia. In the viral infections, although antibody titres are accepted as a measure of the degree of protection, there are certain anomalous findings: for example, high titres of neutralising antibody have occasionally been found in the early stages of fatal cases of smallpox.

The role of immunisation in communicable disease control is best assessed from the results of carefully-designed field trials with vaccines that have been submitted to satisfactory laboratory assays of potency. Thus, BCG, pertussis and typhoid vaccines have been used for half a century or more, but it was only after large-scale controlled trials of these prophylactics had been carried out that a realible assessment of their value could be made. Similar field trials have been carried out for poliomyelitis and influenza virus vaccine, so that public health programmes for the control of these and other infections can now be planned with a reasonable assurance that a degree of effectiveness will be obtained, provided the prophylactic agents can be shown to fulfil certain laboratory requirements. In the use of toxoids, for example, diphtheria and tetanus toxoids, laboratory yardsticks of antigenic potency are available and mandatory under the Therapeutic Substances Act (T.S.A.) regulations. With bacterial and viral vaccines, attempts are now being made to establish minimal requirements for protective efficacy on the basis of correlated field and laboratory studies. For example, a mouse-protection test for pertussis vaccines has been found to give reasonably good correlation with clinical protection. With smallpox vaccines, the most reliable method of testing potency is to do pock-counts on the inoculated chorio-allantoic membrane of the chick embryo, and this method is now recommended as the International Standard Test.

Immunisation Against Specific Infectious Diseases

The case for prophylactic immunisation of a child community against specific infectious diseases will depend on a number of factors; *e.g.* the prevalence and economic importance of the infection; the relative value of immunisation compared with other control measures; the safety, efficacy and practicability of the immunisation procedure; the control of non-endemic infections which may be introduced from another country, *e.g.* smallpox.

Infectious diseases against which immunising agents are presently available may be conveniently divided into two groups; (i) those in which there is no satisfactory method of control other than by vaccination, *e.g.* smallpox, diphtheria, whooping-cough, tetanus, poliomyelitis, influenza; and (ii) those in which prophylactic vaccination would be useful along with other control measures, *e.g.* tuberculosis and typhoid.

Although prophylactic vaccination is the only reliable control measure in the first group, it is doubtful if in any particular country there is a case for large-scale immunisation against all of them. Each country should therefore prepare its priority list according to its own known needs. At the top of this list for most countries would be smallpox for a variety of reasons. Diphtheria should be high on the list since this preventable infection is still too prevalent in many countries. With diphtheria would be associated whooping-cough because of its high incidence and severity in infancy, and because the two prophylactic agents can be usefully combined. Active immunisation against tetanus is frequently combined with diphtheria and whooping-cough immunisation, in some countries because tetanus in childhood is still a sizeable hazard, in others because active immunisation has advantages over passive protection with antitoxin. Poliomyelitis would be high on the list in the more developed countries where clinical infections are common, but would not yet be required in many developing countries despite evidence of a high incidence of inapparent infection. Immunisation against influenza has more restricted applications, *e.g.* in school children among whom the first wave of infection during epidemics frequently occurs.

Tuberculosis might seem to be a preventable infection belonging to the first rather than the second group, but some countries, *e.g.* the United States of America, prefer to use other public health measures for its control, while in certain areas with a high incidence of low degree tuberculin sensitivity, the prophylactic value of BGC vaccination is still in doubt. Typhoid fever is a prevalent infection in many of the developing countries; in Ceylon with a population of nine millions it is estimated that some 20,000 cases of typhoid occur annually, and the disease is prevalent in many Latin-American countries. The long-term control of this infection depends on good standards of environmental sanitation and household hygiene. Vaccination may play a useful part as a short-term prophylactic measure.

The rationale and procedures for immunisation against some of the specific infectious diseases of childhood will now be briefly outlined.

Smallpox. Although smallpox has ceased to be an endemic infection in the United Kingdom, the risk of its importation has increased with modern swift travel facilities. Air passengers from endemic areas such as India and Africa may arrive in Great Britain in the incubation stage of the infection, which, if the individual has been previously vaccinated, may appear in a modified and not easily recognisable form. When, after the importation of a primary unrecognised case, a crop of secondary cases occurs, there is liable to be a stampede towards mass immunisation, including the vaccination of many persons for the first time. In these circumstances, the serious sequelae, *e.g.* post-vaccinial encephalitis, of primary vaccinations in schoolchildren may cause more sickness than the smallpox outbreak itself.

Mass campaigns for the eradication of smallpox in endemic areas are now being planned and executed, and already, in a number of Latin-American countries, these campaigns have been successful in getting rid of smallpox as an endemic infection. Until all endemic areas have been cleaned up, however, the official policy in countries such as the United Kingdom must be to encourage primary vaccination and re-vaccination at as high a level as possible. The primary vaccination rate ranges from 40 to 50 per cent of children under five years in Britain or may be much higher following importations of smallpox as happened in 1962. Since the risk of complications is greater when primary vaccination is done in infancy than in the age period one to four years, it is now recommended that primary vaccination should be done in the second year of life, although it is often administratively more convenient to vaccinate infants between three and six months of age. The method of choice is the multiple pressure technique, as recommended in the Ministry of Health memorandum (1956) on vaccination.

The most suitable site for vaccination is the upper arm, although some doctors prefer to vaccinate girls on the inner aspect of the ankle. Revaccination should be carried out at school entry and after that probably only when the subject is going abroad, particularly to an endemic area or to a country where a certificate of recent vaccination is compulsory.

Diphtheria. Although the spread of diphtheria, unlike smallpox, is associated to a considerable degree with symptomless carriers, it is possible that, like smallpox, diphtheria could be eradicated by the maintenance of a high and persistent level of artificial immunisation. The close correlation between the initiation and widespread application of active immunisation and the steady fall of both morbidity and mortality rates, can leave no doubt about the effectiveness of this procedure. In the United Kingdom some eighty health authorities have not had a single notification of diphtheria for five years or more. If diphtheria should occur in an immunised person, it is usually a local non-toxic infection, the ratio of death in immunised and non-immunised persons of the same age group being in the range from 1 : 5 in pre-school children to 1 : 10 in schoolchildren. The data for the United Kingdom for the years 1954–63 are given in Table 16, and may be contrasted with an annual average of 55,125 cases and 2,783 deaths for the decade immediately preceding large-scale immunisation. It is generally agreed

TABLE 16

Diphtheria. Notified cases and deaths (1954–63) *in England and Wales*

	Corrected notification	Deaths	Fatality ratio (deaths per 100 notifications)
Annual average, 1933–42	55,125	2,783	5·0
1954	173	8	4·6
1955	155	12	7·7
1956	53	3	5·7
1957	37	4	10·8
1958	80	8	10·0
1959	102	0	0·0
1960	49	5	10·2
1961	52	10	19·2
1962	16	2	12.5
1963	33	2	6·1

that diphtheria can be brought under control in a community when some 70 per cent of both pre-school and schoolchildren are effectively immunised and it may be noted that in England and Wales with an 'immunisation index' of 57 per cent for children under fifteen years of age in 1963. Notifications have fluctuated between 16 and 173 in the past ten years, related usually to localised outbreaks among school children.

The essential requirements for the control of diphtheria are the selection of an effective prophylactic and the establishment of a sound immunisation programme in which the main considerations are the age at which immunisation is begun, the dosage of the antigen and the proportions of the child community who are inoculated. The continued prevalence of diphtheria in a number of countries where adequate facilities for carrying out effective immunisation programmes would seem to exist, is a matter of some concern and may be used as a basis for inquiry into the reasons for the failure to control diphtheria. As regards the antigen, the most potent preparations are those containing alum and of these the most reliable and reproducible is a purified toxoid adsorbed onto aluminium phosphate (PTAP), which in a single injection gives an antitoxin response in the guinea pig five times greater than does a toxoid adsorbed onto alum hydroxide (APT). Two doses of an alum-adsorbed toxoid given at an interval of not less than four weeks to a child six to nine months of age will produce an adequate antitoxin response to protect the child against toxic diphtheria for a period of three to four years. When diphtheria toxoid is used with tetanus toxoid, an alum-adsorbed preparation may be used for the primary course of immunisation although there is a small risk of inducing post-inoculation poliomyelitis with alum-containing vaccines. In recent years there has been an increasing tendency to use diphtheria and tetanus toxoids in combination with pertussis vaccine. In such a mixture the bacterial suspension has some adjuvant effect on the potency of the toxoids but is less reliable in this respect than is alum. It is, therefore, recommended that three doses be given, again at intervals of not less than one month. Because maternally transferred antibody interferes with the antitoxin response in very young infants in whom, also, the antibody-forming mechanism is still immature, diphtheria immunisation may be begun about the third month of life, particularly if it is being combined with pertussis vaccine when the need for early immunisation is related to the greater severity of whooping-cough in infancy. If a course of combined diphtheria-tetanus-pertussis prophylactic is begun about the third month of life, it is recommended that a booster dose be given about a year after the primary course. Where there is likely to be difficulty in giving two or three doses at monthly intervals, a powerful antigen like PTAP should be used in an adequate dose for the first inoculation. In these circumstances a second dose given six months later will still produce an adequate antitoxin response.

The failure to control diphtheria in some countries is probably related most often to the failure to carry out the immunisation programme effectively, that is to give some 70 per cent of pre-school children the primary course and to follow this with a booster dose about the time of school entry. An indication of the effectiveness of an immunisation campaign directed primarily at the pre-school and schoolchildren is the tendency for a shift of both cases and deaths to higher age-groups.

Whooping-cough. One of the most prevalent of the specific childhood fevers is whooping-cough; some 40 to 50 per cent of children are affected before their fifth birthday and 70 per cent by the age of ten years. In the period 1940–48 this infection killed three times as many infants under one year in the United States of America as measles, mumps, chicken pox, scarlet fever, diphtheria, poliomyelitis and meningitis all together. Death rates in the first year are ten times greater than in the one to four-year-olds, and at least a hundred times greater than in the five- to nine-year-olds. Although mortality rates in the United Kingdom have fallen precipitously in the past two decades whooping-cough can be a protracted debilitating infection in young children with both physical and mental complications such as broncho-pneumonia, bronchiectasis and behaviour disorders. The causative organism, now called *Bordetella pertussis* in recognition of Jules Bordet, its discoverer, is antigenically homogeneous but early attempts to prevent whooping-cough by prophylactic vaccine were unsuccessful, largely because 'rough' laboratory strains which did not contain the protective antigen were used. When, later, field studies in the United States of America showed that vaccines could be made that give a considerable degree of protection, interest was renewed and a series of controlled trials with pertussis vaccines were carried out under the auspices of the Medical Research Council (Reports 1951, 1956, 1959*a*). The degree of protection varied considerably but, with a good vaccine, clinical infection in the ratio of 1:7 to 1:10 in the inoculated and control groups or a reduction in the attack-rate among 'home exposures' from 80 to 90 per cent in the unvaccinated to 10 to 20 per cent can be expected. Three doses of plain pertussis vaccine, each containing 20,000 million organisms, are given at monthly intervals, and because of the early incidence of the disease (about 10 per cent of children are affected in the first year of life) immunisation should be begun in the second or third month. In the U.S.A. two doses of an alum-containing vaccine have been found to give reasonably good protection to infants under six months of age, and a British trial of a purified fraction containing about 0·1 per cent of the total bacterial protein gave very good results, although there was a higher incidence of local and systemic reactions than with the whole bacterial vaccine (Report, 1959*a*). Where a good vaccine does not give complete protection, the attack is usually of a mild and modified nature but children with such atypical attacks may be a source of danger to younger unprotected siblings. Because of this risk and particularly when pertussis vaccination is not begun in the first six months of life, it may be advisable to give a booster dose to older siblings at school entry.

Large-scale field trials of vaccines are very expensive and time-consuming and therefore in the Medical Research Council trials every effort was made to find a suitable laboratory test that might be correlated with the results of the field trials. The most satisfactory test was the mouse-protection test, but even here certain vaccines show discrepancy between the performance in the laboratory and in the field (Report, 1959*a*).

The prophylactic use of gamma globulin in home contacts has not been found to be an effective means of control (Morris and McDonald, 1957).

Tetanus. Tetanus is a very rare disease in civilian practice in Great Britain, with not more than 40 to 150 cases per annum and on average 45 deaths per annum in the decade 1953–62. However, in developing countries, particularly those with large agricultural communities, tetanus following injuries of various kinds can be a serious problem and in many, neonatal tetanus is still an important cause of infant mortality. As examples of the size of the problem approximately 1,000 cases of tetanus are admitted annually to hospital in Ceylon, while pilot studies carried out in one part of rural India indicated that tetanus was one of the ten major causes of morbidity and mortality in that area. Again, neonatal tetanus has been shown to occur in over one per cent of births following confinement at home in the Dakar area of Senegal and accounts for 20 to 80 per cent of the deaths from tetanus at all ages in a number of countries. In countries where tetanus is a public health menace, active immunisation begun in early childhood and maintained by booster doses on entering and leaving school, would seem the obvious answer. Tetanus toxoid is a potent and cheap antigen which can be used in combination with other prophylactics such as diphtheria toxoid and pertussis vaccine or with typhoid vaccine.

The problem of neonatal tetanus presents some practical difficulties. Immunisation of the pregnant woman so that the baby would be born with an adequate amount of antitoxin to protect it against neonatal infection might seem to be the obvious answer. There seems little doubt that if this could be done, the problem of neonatal tetanus could be solved, although controlled trials to test the validity of this assumption need to be carried out. The practical difficulty is that a great part of neonatal tetanus occurs following childbirth at home where there has been no antenatal supervision of the pregnant woman. It would obviously be difficult to arrange for these women to have active immunisations during pregnancy. An alternative solution, *viz.* the administration of tetanus antitoxin to the baby at birth, as is now being done at Dakar, also presents practical difficulties and it seems that extension of maternity nursing care may be the eventual answer.

In the more developed communities the current prophylactic procedure against the risk of tetanus among civilians suffering injury, is to give a dose of tetanus antitoxin which will give protection for a few weeks. The main objections to this method of control are: (*a*) the considerable cost of the antitoxin and the many thousands of cases of serum sickness that still occur after its use; in addition, acute anaphylactic deaths may rarely follow injections of antitoxin; (*b*) the patient who has already had an injection of antitoxin and requires a second dose within a period of one to two years, may eliminate the second dose of antitoxin very quickly, so that it ceases to have any protective value. In addition, such patients are more likely to have anaphylactoid reactions; (*c*) a considerable proportion of the clinical cases of tetanus follow mild injury when the patient has not been seen by a doctor.

There is therefore in these countries increasing support for active immunisation against tetanus on a national scale. Experience with this form of immunisation among troops on active service during the second world war demonstrated how effective it was as a prophylactic against tetanus when the incidence was reduced to less than 0·1 per 1,000 wounded. Any individual who has had a course of active immunisation and suffers injury requiring anti-tetanus treatment, is given a further booster dose of tetanus toxoid. Unfortunately it is often impossible to tell with an injured person whether he has had active immunisation against tetanus and therefore the hospital officer feels obliged to give a dose of tetanus antitoxin. Some reliable and easily ascertainable method of recording immunisation is urgently needed. The usual arrangement is for the individual to have a personal immunisation card on which his various vaccinations have been recorded but unfortunately these cards get lost or mislaid and are not available when they are most needed. Alternatively, the use of a metal or plastic disc (to be worn round the arm or neck) on which the immunisation history is recorded, has been recommended. It has even been suggested that a small tattoo mark inside the ankle or on the iliac crest, could be applied when active immunisation is completed and would be readily noticed by any doctor examining an injured patient. Where a non-immunised individual has been given a dose of tetanus antitoxin following an injury, an effort should be made to give him active immunisation, since further doses of tetanus antitoxin are unlikely to give protection. A first dose of adsorbed tetanus toxoid may be given at the same time as the antitoxin to be followed six weeks later by a second dose.

Poliomyelitis. The efficacy and safety of killed (Salk type) poliovirus vaccines have now been fully confirmed by large-scale use in many countries. However, a number of objections have been raised against killed vaccines. For example, the response after a course of three injections may not persist so that repeated booster doses may be needed and in some countries a fourth injection is already officially recommended. Again, infants with maternal antibody do not respond satisfactorily to the vaccine, and in older children, the antibody response to the most important component (type 1 poliovirus) was relatively poor with the then current vaccines. From the time that the application of poliovirus vaccines became a practical possibility, several virologists have devoted their activities to the production of an attenuated live vaccine which could be administered orally. The advantages claimed for live over killed poliovirus vaccines are set out in Table 17 but some of the claimed merits of the live vaccine may be more apparent than real as the comments that follow will show.

Antibody response. The poor response of the type 1 virus in some poliomyelitis vaccines can be overcome by trebling the concentration of the type 1 virus component or using a specially purified vaccine. On the other hand, studies of the antibody response to the live vaccine show that antibody will not be demonstrable if for any reason infection of the alimentary tract is not achieved, *e.g.* if too small a dose is given or if there is interference by other viruses.

Ease of administration. The three or four injections of killed poliovirus vaccines may in future be combined with other prophylactics, *e.g.* diphtheria-pertussis, and some encouraging results have already been reported from such a combined vaccine, provided it is not given too early in infancy. In order to obtain a satisfactory response the oral vaccine has to be given in two or three repeated doses of the trivalent vaccine; or monovalent vaccines, in the order types 1, 3 and 2, may be given in successive monthly doses.

Alimentary tract infection. The killed vaccine does not prevent natural infection of the alimentary tract so that poliovirus may persist in a well-immunised community. However, the alimentary tracts of children which have become parasitised by attenuated polio viruses, may some time later become susceptible to re-infection with 'wild' virus.

Cost. The living vaccine is much cheaper to produce although control of its safety and preservation of its potency may present practical difficulties.

TABLE 17

Comparison Between Killed and Living Polio-virus Vaccine

	Killed vaccine	Living vaccine
1. Antibody response	Variable especially to type 1	All fed with virus produce antibody if the intestine becomes infected
2. Administration	3 to 4 inoculations	2 to 3 oral doses (see table 19)
3. Subsequent infection of the intestine by natural viruses	Not prevented	Prevented
4. Safety	Failure of inactivation (cf. the Cutter disaster)	Possible reversion of the vaccine strain to virulence
5. Effectiveness	Has partially failed in U.S.A. and Canada (1959 data)	The immunity should be as good as that after natural infection
6. Herd immunity	Only increased by increasing the number of persons inoculated	Increased by spread from the vaccinated to their contacts

Safety. Since the Cutter accident with imperfectly inactivated vaccine in 1955, laboratory standards for safety have been much more rigid and a close surveillance of the vaccinated population for cases of paralytic poliomyelitis following vaccination has produced no evidence of any such risk. With live vaccines the main danger is that the attenuated strain might, during growth in the gut and transmission to new hosts, revert to a more virulent form. There is evidence that some return to neuro-virulence may occur after human parasitism but that this reversion is not progressive. A careful follow-up of large numbers of vaccinated children in the U.S.S.R., Czechoslovakia, the Americas and elsewhere gives good ground for believing that the live vaccine is remarkably safe, although in Canada and U.S.A. a few cases of clinical infection due to type 3 vaccine strain have been recorded.

Effectiveness. There is now a large body of evidence that a course of three doses of killed poliovirus vaccine gives a high degree of protection, probably over 90 per cent. The so-called failures of the vaccine in the United States of America and Canada in 1959 occurred in areas where the level of immunisation was inadequate; that is, in overcrowded low income areas, particularly in the negro quarters and most cases occurred among unvaccinated children. Although there has been no properly controlled assessment of the protective value of live vaccine against paralytic polio there is ample evidence to show that it is effective.

In some areas, however, especially where sanitation and hygiene are poor and other enteroviruses widespread, interference by 'wild' viruses with the live vaccine virus may prevent infection and hence immunisation. This may prove a serious drawback to the use of live vaccine in tropical and subtropical regions where the enteroviruses are common. Vaccination in early infancy may overcome this difficulty although parasitisation of the alimentary tract of the neonate is less successful than in infants a few months old.

Herd immunity. An apparent advantage of the live vaccine is that it spreads within the community and so protects non-vaccinated as well as vaccinated members. But there is evidence that this spread may be quite limited, for example, among close contacts in nurseries and that only young children are likely to disseminate the virus among family contacts. Again, spread may be inhibited by previous infection of the gut with other enteroviruses.

Measles. The virus of measles was first isolated in tissue culture from the blood and throat washings of patients in the early stages of infection by Enders and Peebles (1954). After repeated passage the virus was adapted to growth on chick embryo tissue with resultant attenuation in its virulence. Living vaccines prepared from this attenuated strain have given a high degree of protection against measles in field trials but the injection is followed by a febrile reaction (102° to 103°F.) in 30 to 40 per cent of the inoculated children. This febrile reaction can be damped down by the injection of a small dose of gamma globulin at the time the vaccine is given but gamma globulin is expensive and the supply is limited so that this modification is not satisfactory for large scale use.

An alternative procedure is the use of killed vaccine in three doses at monthly intervals or one to two doses followed by an injection of the living attenuated vaccine. The latter schedule, if begun after eight months of age when passive immunity will have disappeared, gives a high degree of protection with little untoward reaction; the killed measles vaccine could be combined with the DPT vaccine.

The large question facing the medical profession is whether or not to recommend the widespread use of measles vaccine. The family doctor and the paediatrician are perhaps not impressed with the need to protect healthy children against measles which nowadays is usually an uncomplicated childhood fever of a few day's duration. From the public health viewpoint, however, the problem looks different. An uncomplicated case of measles needs two or three visits from the doctor and there are upwards of a million cases in the epidemic wave every year. Again, the incidence of complications is not negligible. In a recent analysis of some 53,000 notified cases occurring in the Northern conurbations in 1962–63 (it was reckoned that about 80 per cent of the cases were notified), Miller (1964) found that one in fifteen had rather serious complications of which the most common were bronchitis and pneumonia (38 per 1,000 of the affected children), acute otitis media (25 per 1,000) and neurological disturbance (4 per 1,000), including encephalitis at about 1 per 1,000. Thus, during a measles year there may be some 35,000 children with serious complications, of whom 6,000 to 8,000 will require hospital treatment. This gives measles a rather different complexion as a public health problem and provided the measles vaccine is *safe* and *effective*, there is probably a case for its large scale use, particularly in industrial urban areas.

In many developing countries where morbidity and mortality rates from measles are still very high, there is an urgent need for the widespread use of measles vaccine.

Gamma globulin may be used to prevent or modify an attack of measles in young children intimately exposed to the risk of infection. In children between six months and two years of age, or in those who are particularly susceptible to infection, it may be thought advisable to aim at complete protection but otherwise a dose of gamma globulin is given which will result in a mild, modified attack if the child does develop the infection. Table 18 sets out appropriate dosages for prevention or modification.

TABLE 18

Gamma Globulin in Measles Prophylaxis

	Age of child		
Aim	Under 1 year	Over 1 year and under 3 years	Over 3 years
Prevention	3 ml* (250 mg)	6 ml (500 mg)	9 ml (750 mg)
Modification	3 ml (250 mg)	3 ml (250 mg)	3 ml (250 mg)

* The volumes refer to 10 per cent solution of gamma globulin.

Influenza. Epidemics of influenza due to virus A occur in Great Britain at two to four-year intervals and outbreaks of virus B influenza in less frequent cycles. Incidence tends to be highest among children and in semi-closed communities, for example, boarding-schools, secondary day schools, and institutions. These epidemic waves cause a sudden marked increase in sickness absenteeism in schools and industry and although uncomplicated influenza is not a serious infection, its high attack rate may cause considerable dislocation of education and upset the public economy. Obviously any specific prophylactic measure that might lessen this burden would be well worth while.

Since 1951, a committee of the Medical Research Council has organised a series of controlled trials of influenza virus vaccine. These trials have been carried out in industrial communities, universities, the fighting services, schools and so forth. Initially the control groups were given a bacterial vaccine but in later trials different virus A and B vaccines have been used on comparable groups of volunteers. The overall results have shown a reduction in sickness absenteeism of approximately 40 per cent among those vaccinated against the prevalent virus infection compared with the control groups. These rather disappointing findings may be due to either (*a*) the failure of the vaccine to give adequate protection or (*b*) the possibility that the method of assessment may be incapable of measuring the true degree of protection against virus influenza.

A clinical diagnosis of 'influenza' is bound to include respiratory infections due to other viruses. However, outbreaks of febrile respiratory illnesses among semi-closed communities, *e.g.* boarding schools, are more likely to be homogeneous and if shown by laboratory investigations to be due to virus influenza, opportunities for a fairer assessment of the protective value of the vaccine may be obtained. A striking example comes from the experience in a sharp outbreak of authenticated virus A influenza in a large residential school where about half of the boys had been given prophylactic vaccine (Hawkins, Hatch and McDonald, 1956). Compared with an attack-rate of 20 per cent among the uninoculated boys, the incidence was only 2 per cent among boys who had been inoculated twice (fourteen months and three months respectively before the outbreak) and it varied from 8 to 12 per cent among boys given one injection either three months or fourteen months before the outbreak. These findings suggest that two injections of an appropriate influenza virus vaccine at one year's interval will give children a high degree of protection against the infection.

In more recent trials with Asian influenza vaccine, the most encouraging results came from a group of public schools where the boys received one injection of the vaccine on reassembly after the summer vacation. Influenza struck a number of these schools at about the time the boys received their inoculations; the groups receiving the Asian virus vaccine developed a considerable degree of immunity about eight days after their injections when the attack-rate dropped abruptly to one-third of the incidence in the other two groups receiving respectively a polyvalent A (non-Asian) and a B virus vaccine (Report, 1958). A technical advance which may result in better and more prolonged protection against influenza is the use of a water-in-mineral oil emulsion in which the vaccine is incorporated. With doses of this oil adjuvant vaccine equivalent to one-fifth of the ordinary saline vaccine, the antibody titres are considerably higher and persist at a high level for a year or more after a single injection. A polyvalent vaccine of this kind containing influenza A and B viruses and adenovirus types 4 and 7 gave a high degree of protection against febrile respiratory infections among troops in training (Meiklejohn, 1962).

Tuberculosis. Despite epidemiological evidence, particularly from Scandinavian countries, of the protective effect of BCG vaccination, there were until recently very few well-controlled trials from which a critical assessment of the vaccine could be made. Now, controlled field trials in different age-groups and communities, *e.g.* in the United States of America, the United Kingdom and Algeria, have shown that BCG and vole bacillus vaccines can give a high degree of protection (around 80 per cent) to vaccinated infants and adolescents, and that this protection may persist for ten years or more after vaccination. In the U.K. study with schoolchildren (aged fourteen to fifteen years on entry) in three industrial areas the attack rate for clinical tuberculosis in the BCG vaccinated group (14,000) during the first five years follow-up was 0·38/1,000 and for the corresponding control group (13,000) it was 2·29/1,000 or a reduction of 83 per cent (Report, 1959*b*). The protective effect of BCG vaccine in the adolescent has been corroborated in controlled trials for infants (Rosenthal, 1955, 1956;

Sergent, Catanei and Ducros-Rougebief, 1956), for American Indian subjects in the age-range from infancy to twenty years (Aronson, Aronson and Taylor, 1958), and for schoolchildren (Hyge, 1947, 1956). In contrast, the first reports of two large trials under the United States Public Health Service in Puerto Rico and in Georgia and Alabama, in which children and young adults were the volunteer communities, indicated that the benefit to the inoculated groups was only in the neighbourhood of 31 to 36 per cent. This low rate of protection may be related to the occurrence of the phenomenon of low-grade tuberculin sensitivity, associated perhaps with infection by mycobacteria other than the tubercle bacillus, which may confer a certain degree of specific antituberculous immunity (Palmer, Shaw and Comstock, 1958).

Among children in the U.K. study who gave strong positive reactions to three tuberculin units (T.U.) on first testing, there was an annual incidence of tuberculosis of 3·5 per 1,000 in the first two-and-a-half years, and 1·67 in the second two-and-a-half years. In contrast, the annual incidence among those with weaker positive reactions to three T.U. or positive only to 100 T.U. was respectively 0·77 and 0·73 per 1,000 in the first two-and-a-half years and remained at these levels. This interesting finding should act as a warning to medical staff who are engaged in active immunisation of school-leavers to follow up carefully for the first few years any children giving a strongly positive tuberculin reaction. Alternatively, the age at which BCG vaccination is to be recommended for the schoolchild might be advanced from the present recommended age of thirteen years to about ten to eleven years in the hope that earlier vaccination would protect some of those who become infected at the time of puberty and are likely to develop clinical tuberculosis.

Besides the recommendation that schoolchildren in the U.K. should be offered BCG vaccination if they are tuberculin-negative, other groups at special risk, such as babies born into a tuberculous family should of course be offered this protection.

Combined Antigens

Practically all substances used as prophylactics, whether they be whole bacterial or viral vaccines or bacterial toxoids, contain more than one antigen. The host's tissues respond to these multiple antigens by the production of specific antibodies to each, and seem to have the capacity to respond to a considerable number of separate antigens given simultaneously, provided each antigen is present in adequate amount.

It is important when using combined antigens to see that they are well balanced so that a powerful antigen does not mask the effect of a weaker. For example, tetanus toxoid is a more efficient antigen than is diphtheria toxoid and the usual mixture is five flocculation equivalents of tetanus toxoid to 25 flocculation equivalents of diphtheria toxoid. Again, the type 1 polio virus is a poorer antigen than types 2 and 3, and the present tendency is to double or treble the amount of type 1 virus in the killed polyvalent vaccine in order to obtain a better type 1 antibody response. A point that may have some practical importance is that if combined antigens, for example, diphtheria and tetanus toxoids, are given to a child that has been immunised already against one component of the mixture, say diphtheria toxoid, the booster effect of the latter may be so marked as to interfere with the primary response to the other antigen (Barr and Llewellyn-Jones, 1953).

The advantages of using combined antigens compared with single antigens, for instance, pertussis vaccine plus diphtheria and tetanus toxoids (D.P.T.) are: (*a*) the reduction in the number of injections; (*b*) the adjuvant effect of the bacterial component on the toxoid; and (*c*) the fact that immunisation against diphtheria and tetanus, which are rare hazards, is acceptable by the public if combined with immunisations against a prevalent or dreaded infection such as whooping-cough or poliomyelitis. Disadvantages are that (*a*) the optimum age for immunisation against whooping-cough is early in infancy and for diphtheria and tetanus rather later; (*b*) if babies are given a course of immunisation of this triple vaccine in the first six months of life, a booster dose will be needed about a year later and this may be administratively difficult; (*c*) if one component of the mixture, say the pertussis vaccine, is a poor antigen, its inadequate protective effect may adversely affect the acceptability of the combined vaccine; (*d*) there is a slightly greater risk of provocation poliomyelitis with combined bacterial-toxoid vaccines than with single antigens. The possibility of adding killed poliovirus vaccine to the other three components has been explored but the interfering effect of passively-transferred antibody to polio vaccine in infants under six months and the possible deleterious effect of the mixture on the pertussis antigen, are contra-indications to this quadruple vaccine and the present policy in the United Kingdom is not to recommend it for primary immunisation in infancy.

TABLE 19

Suggested Schedule of Immunisation in Areas with Adequate Public Health Medical Services

Age	Visit	Vaccine	Injection	Interval
1 to 6 months	1	Diphtheria, Tetanus, Pertussis	1	4 to 6 weeks
	2	Diphtheria, Tetanus, Pertussis	2	4 to 6 weeks
	3	Diphtheria, Tetanus, Pertussis	3	
7 to 11 months	4	Poliomyelitis (oral)*	–	4 to 8 weeks
	5	Poliomyelitis (oral)	–	4 to 8 weeks
	6	Poliomyelitis (oral)	–	
18 to 21 months	7	Diphtheria, Tetanus, Pertussis	4	
Smallpox vaccination during the first two years, preferably in the second year				
School entry		Diphtheria and Tetanus		
8 to 12 years		Smallpox revaccination		
Over 12 years		BCG		

* *Poliomyelitis.* If a child has had two doses only of Salk vaccine he should receive two further doses of oral vaccine to complete the primary course. The second dose could be at a convenient time such as school entry.

Children who have already started a course of immunisation with killed vaccine may, at the doctor's discretion, either complete the course or be given oral vaccine, as follows:

(i) If a child has had only *one* injection of Salk vaccine, a full course of three doses of oral vaccine should be administered.

(ii) If a child, aged five to twelve years, has had *three* injections of Salk vaccine, the fourth injection may be replaced by one dose of oral vaccine.

TABLE 20

Suggested Schedule of Immunisation in Areas with Inadequate Medical Services

Age	Prophylactic vaccine	Visit
0 to 4 weeks	(1) BCG vaccination*	1st
3 to 9 months	(2) Smallpox vaccination (3) Diphtheria, Pertussis, Tetanus (triple vaccine with alum): two doses at an interval of 1 to 6 months The first injection could be given at the time of smallpox vaccination. Smallpox vaccination is verified at the second visit. Failures of smallpox vaccination are re-vaccinated	2nd and 3rd
School entry or soon thereafter	(4) Diphtheria/tetanus booster (plain or with alum) (5) TAB vaccination: two doses at an interval of one month (6) Smallpox re-vaccination: at the time of second TAB injection	4th and 5th
10 to 14 years	(7) BCG re-vaccination (8) Smallpox re-vaccination (9) TAB booster	6th and 7th

**Tuberculosis.* BCG vaccination. High-prevalence areas: first vaccination within first four weeks of life or, where the modified vaccination schedule is used, BCG vaccine may be given at the same time as the second dose of triple vaccine at four to eight months of age. Pre-vaccination tuberculin testing may have to be done at this age, depending upon the infection risk during the first year of life. Re-vaccination at school leaving age, after tuberculin test.

Low-prevalence areas: first vaccination—in school or before leaving school after tuberculin test.

Immunisation Programmes

The aim of immunisation programmes is the control of infection in the community rather than individual protection. A lower level of immunity than is necessary for solid individual protection can effectively reduce the incidence of communicable diseases if a high proportion of the susceptible community is immunised.

In some areas most of the immunisation work is done at child welfare clinics and in others a large proportion of it is done by the family doctor or paediatric specialist. Though there are obvious advantages in having the immunisations carried out by the family doctor (and statistics indicate that the proportion of immunisations done by practitioners is steadily increasing), it is essential that there should be a well-organised system for ensuring that the child receives its injection at the appropriate age and time intervals and that there is an efficient system of recording the immunisations. An immunisation campaign carried out without provision for its continuation as a routine procedure will not give satisfactory results—except perhaps where complete eradication has been achieved.

Limited public health facilities and finance, shortage of trained staff and difficulties in enlisting the co-operation of the community, make it necessary to devise different immunisation programmes for countries in varying stages of economic development. The general aim must be to immunise regularly and economically, with the minimum number of visits and injections, a sufficiently high proportion of the susceptible population.

Knowledge about the duration of immunity following the primary course of immunisation and after booster injections is not yet sufficiently precise in a number of communicable diseases, so that the number and timetable of booster doses must be left rather elastic. The need to use efficient and if possible standardisable prophylactics cannot be over-emphasised since the continuance of immunisation programmes with the co-operation and confidence of the public depends on the successful results of these procedures.

The two schedules set out in Tables 19 and 20 are suggested respectively for countries with well-developed medical services and for developing countries with inadequate medical services.

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PART II

SOCIAL ASPECTS OF CHILD HEALTH

Chapter 11

THE DEVELOPMENT OF THE CHILD HEALTH SERVICES

Historical

IN eleventh-century Scotland, Queen Margaret made herself personally responsible for the daily care of nine orphans, and during the fourteenth and fifteenth centuries religious hospitals throughout Britain accepted the care of infants of mothers dying in childbirth in these hospitals, In the sixteenth century, baby-farming became an organised trade as, with the practice of wet-nursing steadily increasing, many infants were sent into the country to foster-mothers. Indeed, baby-farming continued as an accepted practice well into the nineteenth century. Under the Elizabethan Poor Law and the contemporary Scottish Poor Law, both of which remained in force practically unaltered into the nineteenth century, poor children were subjected to harsh, repressive measures, all the emphasis being on servitude. Nevertheless, isolated attempts were made to improve the lot of orphans and foundlings, and Christ's Hospital was founded (1553) while church records in Scotland bear frequent references to the relief of poor and orphaned children.

By the publication of Bills of Mortality during the seventeenth century some idea of child mortality was gained for the first time. Two-fifths of all deaths were in infants under two years and the mortality among farmed-out children was enormous. Factory schools were started for destitute children by Firmin in London (1681) and Spinning Schools in Scotland (1633). The care and education of deaf children were furthered by such as John Bulwer (1644) and John Wallis (1652), but medical care of children generally was non-existent though efforts were made to regulate midwifery practice by, among others, Peter Chamberlen II, in 1616.

No progress was made during the early eighteenth century, though further attempts to improve midwifery practice were made at Edinburgh (1726) and London (by Manningham, Smellie and others). Wet-nursing was approaching its zenith and was a profitable career for many women who abandoned their infants so as to be able to hire themselves as wet-nurses. Such abandoned or 'dropt' infants in London aroused the pity of Captain Thomas Coram and his unremitting efforts finally led to the foundation of the Foundling Hospital there (1741), and Jonas Hanway reported on the appalling conditions affecting children in parish work-houses. Some progress was made in the medical care of children by the publication during the century of many paediatric works by such men as William Cadogan, George Armstrong, and others. Armstrong, with the help of his brother John, the poet-physician, opened the first Dispensary for the Infant Poor in London (1769), a pioneer effort which ceased its activities in 1781 (Maloney, 1954). This dispensary was in many ways the forerunner of the modern child welfare centre. Another similar dispensary was opened by Lettsom in 1770, and suggestions were made from time to time by such men as Smellie and William Buchan that women and young girls should be trained in child care. By the end of the century, cow's milk was steadily supplanting wet-nursing as an alternative to maternal feeding. During this century also, Thomas Braidwood furthered the training and education of deaf children first at Edinburgh (1760), and later at Hackney, London (1783), and the first asylum and school for blind children was opened at Liverpool (1790). Vaccination was introduced by Jenner (1798) but measles began to replace smallpox as the major killer of children among the epidemic diseases. Thus, the eighteenth century saw the seeds of modern maternal and child care sown but falling on the stony ground of the Industrial Revolution.

The period from 1800 to 1850 may be regarded as the blackest pages in British social history as far as the child was concerned. The inexorable advance of the Industrial Revolution exposed the child to exploitation and misery; child labour became the rule, but against it philanthropic effort attempted to cope. Schools of Industry and spinning schools were organised throughout the country, Robert Owen opened his Infant School at New Lanark (1816), and the Infant School Society was founded in 1824. These infant schools aimed at providing moral training, amusement, and attention to the general health of children of both sexes between the ages of two and six years and may be regarded as the predecessors of the nursery schools of today. For the destitute and poverty-stricken child, John Pounds began the Ragged School movement and was followed by Watson, Chalmers and Guthrie in Scotland. Later, Barnardo and Quarrier interested themselves in orphan children. Lord Ashley, later the Earl of Shaftesbury, became the champion of the child in Parliament and very slowly conditions began to improve as successive Royal Commissions reported and legislative action followed, and one by one children were excluded from various industries. The Poor Law was reformed in both England and Scotland and the new Poor Law remained in force with various amendments for almost another hundred years, but even this reformed law left the child with a hard lot, as Dickens showed in *Oliver Twist*. Even for the more fortunately placed child, life was difficult in a different way, as portrayed in *Jane Eyre*. Social unrest following the French Revolution and the development of industry combined to arouse public opinion to the need of a national system of day-schools, but the movement in this direction was impeded by religious differences. In the field of infant welfare, John Bunnell Davis opened the Universal Dispensary for the Infant Poor in 1816 after ten years of constant effort to interest leaders of the profession in the necessity for such an institution. Davis was far in advance of his time, for he envisaged health visiting and health education by pamphlets couched in simple, effective language.

The year 1870 is, in many ways, an important one in the history of the child in Britain, and much of the development of the modern child health services can be traced to events occurring about this time.

Children's Hospitals, Teaching and Training in Paediatrics

Efforts were made to teach paediatrics systematically at Manchester (1829) and Edinburgh (1837) and about the middle of the century began the children's hospital movement (Great Ormond Street, 1852) and the development of children's wards in general hospitals (Liverpool, 1857). *Pari passu* with this trend came the organisation of outpatient departments, convalescent homes for children, special hospitals, lectureships and facilities for voluntary clinical and systematic instruction in children's diseases, and in 1906 the first chair of Diseases of Children in Britain was founded at King's College Hospital, London. In Edinburgh, in 1931, a chair of Child Life and Health was established, which conveyed the broader conception of the study of the child in health and disease, a characteristic outlook of the twentieth century.

School Medical and Dental Services

School meals and milk. Prior to 1870, schools were provided in England and Scotland by voluntary bodies and the church, and some education was also given to children under the Poor Law, but the great masses of young children received no education. Compulsory education was introduced into England in 1870 and in Scotland two years later. The inclusion of children from the poorest homes within a national educational service made evident that a considerable proportion were unable to benefit from such educational facilities either on grounds of physical defect or malnutrition. Soon, therefore, voluntary bodies began providing meals for necessitous children and this need was recognised in the Education (Provision of Meals) Act, 1906, and the Education (Scot.) Act, 1908, both of which authorised education authorities to provide meals for necessitous children. Since these early measures were introduced, the powers of education authorities have been extended by the Education Act of 1944 for England and the consolidating Act of 1962 for Scotland respectively. In both countries a Milk-in-Schools scheme was introduced in 1934, and since 1946 this school milk (one-third of a pint) has been given free at all grant-aided primary and secondary schools.

Medical inspection and treatment. In 1884, the Medical Officers of Schools Association was founded with the object of promoting school hygiene, and its members were composed of representatives of children's hospitals, public schools, charity schools and of others interested in the health and welfare of schoolchildren. A year after its foundation the Association published a Code of Preventive Rules dealing with the control of infectious disease in schools. The latest edition of the Code, now called Handbook (1962) deals not only with infectious disease but other aspects of school hygiene. In spite of this early interest in the health of schoolchildren, little effective was done for their general medical supervision and treatment, though such was legally possible under certain Acts such as the Education (Blind and Deaf Children) Act, 1893, and Education (Defective and Epileptic Children) Act, 1899. In 1890, the London School Board appointed a school medical officer and Bradford, three years later, made a similar appointment. A growing uneasiness at the high percentage of rejections of recruits for the South African War resulted in a Royal Commission on Physical Training (Scotland) and an Interdepartmental Committee on Physical Deterioration being appointed in 1902 and 1903 respectively. From the recommendations of these two bodies, the School Medical Service was inaugurated. In 1907, the Education (Administrative Provisions) Act required English education authorities to provide for the systematic medical inspection of all children attending public elementary schools and empowered them, if they so desired, to provide certain forms of treatment if approved by the Board of Education. Later, by the Education Act of 1918, specified forms of treatment required to be provided. In

Scotland by the Education (Scot.) Act, 1908, permissive powers were granted to institute medical inspection, and in 1913, medical treatment was made possible when needed by any schoolchild. Thus, school medical officers and school nurses officially came into being in the health services of Britain. Treatment centres were set up at various hospitals, but as the service developed, clinic and treatment facilities came to be incorporated in school buildings. It soon became apparent to school medical officers that much avoidable damage had already been done by the time the children first entered school, and since child welfare schemes came into being after the Notification of Births (Extension) Act, 1915, and the Maternity and Child Welfare Act, 1918, there has been an increasingly closer liaison between these two local authority medical services. All previous powers and duties of education authorities were incorporated in the Education Acts of 1944 and 1962 for England and Scotland respectively. Under the 1944 Act, the Board of Education became the Ministry of Education, and under both Acts the School Medical Service became the School Health Service and provided schemes for medical inspection and free treatment of pupils attending any school, county college, or junior college. Further, whereas formerly there was no obligation on a parent to submit his child to medical inspection, these two Acts make such inspection compulsory. The conduct of medical examinations and inspections are governed by Regulations (1953). Most education authorities provide schemes of treatment for defective vision; minor ailments; ear, nose and throat conditions; skin disorders; orthopaedic and postural complaints; dental conditions. Special arrangements are made for handicapped children, and child guidance centres are provided for the maladjusted. These latter centres were not officially recognised till 1935 and, in 1963, there were 325 centres in England and Wales in connection with education authorities while in Scotland 24 out of 35 authorities provided child guidance services.

School dental service. From 1870, dentists began to be appointed to some of the bigger public schools, *e.g.* Marlborough, and by 1890 a few dentists, notably Fisher of Dundee, had got to work in a small way in a number of Poor Law schools. By 1898 there were sufficient dentists working among schoolchildren to form the School Dentists Society, affiliated since 1921 with the Society of Medical Officers of Health. Dentists got a firmer footing in schools with the introduction of medical inspections and since then, and especially since 1930, the school dental service has expanded. A few pioneer authorities had also employed dentists in their maternity and child welfare organisations (*e.g.* St. Pancras, 1911). The recent Education Acts have ensured that the School Dental Service becomes an established part of the School Health Service and the National Health Service Acts have enforced a priority dental scheme for expectant and nursing mothers and children under five years. This work is often undertaken by the school dental service. The full development of the service has been impeded by lack of recruitment. The Dentists Act, 1956, permits of the training and employment of dental ancillaries, but it is too early yet to judge the value of these auxiliaries to school dentists.

Infant and Pre-school Services

Practice of midwifery. Following the introduction of the registration of births and deaths in England (1837) and Scotland (1855), the first scientific inquiry of statistical importance relating to maternal care and infant mortality was carried out by William Farr in 1867–69, in collaboration with the Obstetrical Society of London and Dr. William Stark of Edinburgh. This investigation revealed that between 50 and 75 per cent of births in England and 33 per cent in Scotland were attended by midwives with little or no training. *The Lancet* (1868) added its weight to the agitation for the proper training and control of midwives. The Institute of Midwives (now the Royal College of Midwives) was founded in 1881, but in spite of many attempts, no legislation was forthcoming until 1902 when the Midwives Act was passed for England, and 1915 when a similar Act was passed for Scotland. As a result of these two Acts the Central Midwives Boards for the two countries were set up at London and Edinburgh respectively. Since the introduction of the Acts, the training and standard of practice of midwives, and consequently their status, have been raised to a high level and modern legislation governing midwives is embodied in the Midwives Acts of 1951 for the two countries. Antenatal care and its direct bearing on infant mortality were emphasised by J. W. Ballantyne during the last decade of the nineteenth century. The first bed for antenatal purposes was endowed in 1901 at the Royal Maternity Hospital, Edinburgh. Thus, antenatal care is essentially a twentieth-century development.

Baby-farming and the protection of child life. Shortly after the Farr inquiry, public conscience received a rude shock by the trial and execution in 1870 of Margaret Waters, a notorious baby-farmer. In spite of previous efforts by Dr. J. B. Curgenven and Lord Shaftesbury to control the evil, nothing was done until the Society for the Protection of Infant Life (founded 1870) agitated successfully and was largely responsible for getting the Infant Life Protection Act of 1872 passed, by which the registration was made obligatory of persons receiving for gain two or more infants under one year, whilst the passing of the Births and Deaths Registration Act of 1874 was a first step in eradicating the anonymous destruction of infants born in unregistered maternity homes. These homes, however, were not compulsorily registered by local authorities until 1927. A further Infant Life Protection Act was passed in 1897. This Act, in common with several others dealing with the protection of child life, were all contained in the consolidating and amending Children Act, 1908, the 'Children's Charter', which among other provisions, set up Juvenile Courts. This great Act has been superseded by the Children and Young Persons Acts, 1933–63 (England), 1937–1963 (Scotland), and the Children Act, 1958 for both countries. With the end of the Poor Law (since 1930 called Public Assistance) in sight, the Government in 1945 appointed the Curtis Committee in England and the Clyde Committee in Scotland, to review and report on existing arrangements for the care of children deprived of a normal home life. These committees reported in 1946, and both Reports contained similar recommendations. The Curtis Committee showed that there were 124,900 children 'deprived of a normal home life'. In Scotland, 17,607 children were similarly deprived of a normal home life. Both Reports also showed the multiplicity of Government departments and local authority committees, as well as voluntary bodies, concerned with the care of such deprived children. As a result of the recommendations of the two committees, the Children Act, 1948, was passed and became operative in July of that year. Under the Act the Home Office and the Scottish Education Department are the central departments concerned with the supervision of all deprived children. Peripherally, each local authority has a children committee and an administrative officer, the children's officer. The functions of this committee are to administer (*a*) the Children Acts, 1948 and 1958; (*b*) certain parts of the Children and Young Persons Acts, 1933–63, and the Children and Young Persons (Scotland) Acts, 1937–63, which deal with children and young persons committed to the care of fit persons or sent to approved schools or remand homes; (*c*) the Adoption Act, 1958, as regards registration of adoption societies and supervision of protected children; and (*d*) the Matrimonial Proceedings (Children) Act, 1958, concerning children committed to the care of or supervised by the local authority.

Adoption. The problem of the unmarried mother and her child has always been a difficult one, and with the development of infant welfare services before and during the 1914–18 war the problem of the illegitimate infant became increasingly more important. The death rate among such infants was very high and the Registrar-General drew attention to this in 1916. Mainly through the energies of voluntary organisations such as the National Council for the Unmarried Mother and her Child (founded 1918) an agitation was set afoot to put adoption of children on a legal basis, and first the Hopkinson Report (1921) then the Tomlin Report (1925) were published dealing with the question. At last, in 1926, the first Adoption Act in Britain was passed and applied to England and Wales, a similar Act for Scotland following in 1930. These Acts proved inadequate to prevent undesirable adoptions and following the recommendations of the Horsburgh Report (1937) the Adoption of Children (Regulation) Act was passed in 1939. The application of this Act was deferred, owing to the outbreak of war, until 1943. Even after a national consolidating Act (1950) was passed, problems still remained and a departmental committee, the Hurst Committee, was appointed in 1953 to review the existing law relative to adoption and to report whether any changes in policy and prodecure were desirable. Following this committee's report (1954) new adoption legislation was introduced (1958). In 1962, in England and Wales 16,894 children were adopted, and 1,621 in Scotland.

Health visiting. Though nothing immediate appeared to have come from Davis's suggestion in 1816 of home visitation of infants, the necessity of such visiting of the newborn and the offering of advice to the mothers were realised effectively by Thomas Turner, a leading Manchester surgeon. At his instigation the Manchester and Salford Ladies Sanitary Reform Association was formed in 1862, and voluntary home visitation was begun. So successful was this venture that the example was followed in other parts of the country, but it was not until 1892 that a local authority (Buckinghamshire County Council) employed salaried visitors who had received training for the work. Florence Nightingale early realised the importance of this new worker and the need for her to be adequately qualified, and the first official step towards setting up a standard of proficiency for health visitors came in 1908. This was later extended in 1919 by the Board of Education (Health Visitors Training) Regulations. In 1925, the Royal Sanitary Institute was made the examining body for the Health Visitor Certificate, and in 1933, the Royal Sanitary Association of Scotland became the corresponding Scottish examining body. The health visitor was so successful in her work in infant welfare that gradually her training was extended into the fields of school health, tuberculosis, family welfare, etc., and local authorities began to employ health visitors in their school health and tuberculosis services. Legislative recognition of the health visitor and her duties were contained in the National Health Service Acts which defined these duties 'for the visiting of persons in their homes for the purpose of giving advice as to the care of young children, persons suffering from illness and expectant or nursing mothers, and as to the measures necessary to prevent the spread of infection.' Home visiting to give advice and to educate on health matters is thus the primary function of the health visitor and she is now concerned with the family as a whole and not only with mothers and young children, a point emphasised by the working party on the field of work, training and recruitment of health visitors in its report (Jameson Report, 1956). This Report also recommended that a central training body should be set up, a proposal accepted by government when it passed the Health Visiting and Social Work (Training) Act, 1962, under which a Council for the Training of Health Visitors was set up the same year. This Council has already drawn up a syllabus of instruction and will, from 1965, approve courses and training schools, lay down conditions of admission of candidates to such schools, grant a certificate in health visiting after examination, and conduct research. Regulations (1964) govern the employment of health visitors. In 1965 there were 27 health visitor training schools, 24 in England and Wales, and three in Scotland.

Infant welfare. Infant mortality in Britain, far from declining in spite of considerable expenditure of energy and money on sanitary reform consequent upon the work of Chadwick and others, showed a tendency to rise during the second half of the nineteenth century. Notice of this wastage of infant life was quickened by a decline in the birth rate. Interest was focused on epidemic diarrhoea which annually claimed its thousands of victims. Newsholme emphasised the importance of clean cow's milk in artificial feeding and pointed to the success attendant on Budin's *Consultations des Nourrisons* at Paris (1892) and the *Gouttes de lait* of Variot (1893) at the Belleville Dispensary, Paris, and Dufour (1894) at Fécamp. These French organisations, conducted on similar lines, had three main objects, *viz.* the systematic medical supervision of infants, the encouragement of breast feeding, and the provision of sterilised cow's milk for artificially-fed infants. St. Helens (1899) opened the first milk depot in Britain and in succeeding years an increasing number of similar centres were opened throughout the country by both voluntary bodies and municipalities. At some centres free meals were also provided for nursing mothers. These depots rapidly developed into infant consultation centres with health visitors in attendance to give advice on feeding management and problems of infant hygiene. Where courses of systematic instruction were given on infant hygiene to mothers, the centres were often spoken of as 'Schools for Mothers', of which the first was at Winchester (1906). Thus began the association of health visiting and advice to mothers on infant care at centres which later became known as Infant Welfare Centres.

Although registration of births was in force throughout Britain, the time lag was considerable before medical officers of health received information concerning these births, and many of the infants were dead ere the health visitor had visited. Huddersfield (1906) pioneered a system of early notification of births and in 1907 the Notification of Births Act, a permissive measure, was passed requiring that all births, live and still, after the twenty-eighth week of pregnancy should be notified to the medical officer of health within 36 hours of the birth. The Notification of Births (Extension) Act, 1915, enforced the 1907 Act throughout Britain and in Scotland gave local authorities power to organise schemes for the health and welfare of expectant and nursing mothers and children under five years. In England, similar powers were conferred by the Maternity and Child Welfare Act, 1918. In view of the importance of this Act to the organisation of maternity and child welfare schemes by local authorities in England and Wales, it may be appropriate here to summarise its main provisions, though the Act was subsequently repealed by the Public Health Act, 1936. Local authorities were empowered to make arrangements, to be sanctioned by the Local Government Board, for attending to the health of expectant and nursing mothers and of children under five years and who were not attending school. Provision of a general domiciliary service by medical practitioners could not, however, be established by a local authority. Local authorities were directed to establish a maternity and child welfare committee. This might be an existing committee of the authority or a subcommittee of an existing committee, and all matters relating to the exercise of powers under the Act, except the power of raising a rate or borrowing money, stood referred to it. One-third of the members of this maternity and child welfare committee might be co-opted, but these co-opted members required to be persons qualified by training or experience in subjects relating to health and maternity, and the committee had to contain at least two women among its members.

The Local Government Board, superseded by the Ministry of Health in 1919, in its Annual Report for 1917–18 set out a model maternity and child welfare scheme. The following twelve recommendations were made:

1. A health visiting staff sufficient to supervise the expectant and nursing mothers and infants and children under school age in the district who need visiting, to make special visits to children suffering from infectious disease, and to assist at the centres attended by the mothers and infants. On the average, one whole-time health visitor is needed to every 400 births per annum.
2. A maternity and child welfare centre to serve the district of each health visitor in populous areas, at which hygienic and medical advice are provided for expectant and nursing mothers and for infants and young children.
3. Provision of food and milk for expectant and nursing mothers and infants and young children needing nourishment, which they cannot afford to buy for themselves.
4. An adequate service of trained midwives.
5. Arrangements for securing the prompt attendance of a doctor when a midwife needs medical assistance in illnesses connected with pregnancy and confinement.
6. A service of nurses for illnesses of pregnancy and confinement, puerperal fever, ophthalmia neonatorum, measles, whooping cough, and epidemic diarrhoea in young children.
7. Hospital accommodation for acute illnesses connected with pregnancy, confinement and infancy.
8. Maternity homes and homes for infants suffering from malnutrition and other similar conditions which are not ordinarily admitted to hospitals.
9. Convalescent homes for women after confinement and for infants and young children, and rest homes for expectant mothers in certain cases.

10. Accommodation in homes or other arrangements for attending to the health of children of widows, deserted or unmarried mothers.
11. Provision of day nurseries, crèches or otherwise for looking after the children of women who go out to work.
12. 'Home Helps' for taking care of the home during the period of confinement.

Apart from the provision of hospital and convalescent homes, which under the National Health Service are provided by regional hospital boards (7 and 9 above); maternity homes, which are either run privately and registered with and supervised by the local health authority, or are maintained by regional hospital boards (8 above); and accommodation in residential homes for the care of children of widows, deserted or unmarried mothers, which is provided as a rule either by voluntary agencies and subject to inspection by the Home Office, or by the children committee of a local authority (10 above), this original scheme remains in essence what local health authorities strive to provide.

The pre-school child. It is often said that enough is not being done for the pre-school child in contrast to the care given to the infant during his first two years of life and to the scholar. This criticism is a just one, but health authorities are steadily developing special clinics for the health supervision of pre-school children and, of course, health visitors continue their visitations to the homes of these children.

Day nurseries. The day nursery is an agency which provides for the care of pre-school children as well as for infants. Day nurseries or crèches appear to have originated in France after the Napoleonic Wars when large numbers of women entered industrial or other employment. Later, the idea of the day nursery was widely adopted in France and in 1869 the Societé des Crèches was recognised by the French Government. In England, a day nursery was established in London in 1860, and in Scotland one was opened in Edinburgh in 1876, but it was not until the National Society of Day Nurseries (now the National Society of Children's Nurseries) was formed in 1906 that the modern conception of a day nursery as an institution which should be of benefit to both mother and child, gained any general acceptance. During the 1914–18 war, the recruitment of women into industry gave fresh impetus to the movement, and in 1917 there were 137 such nurseries in England and Wales. Official recognition of their value in maternity and child welfare schemes was given by the Maternity and Child Welfare Act (1918) and in Scotland with the Notification of Births (Extension) Act (1915). A second and greater impetus was given during the 1939–45 war and the Government sponsored a war-time day nursery scheme. At the peak period of the war there were some 1,500 nurseries in England and Wales, and 156 in Scotland. In 1946, the war-time nursery scheme came to an end, and the Ministry of Health and the Ministry of Education jointly, and in Scotland the Department of Health, in co-operation with the Scottish Education Department, issued circulars (1945) to local authorities recognising the continued necessity for nursery accommodation. It was therefore clear that such nurseries had not only proved their war-time value but that they formed an essential item in post-war planning. Many local authorities, however, closed down most or all of their day nurseries, sometimes on the grounds of lack of need and sometimes on that of expense. There has been a steady decline in the provision of day nurseries by local authorities. From 1950 when there were 866 day nurseries maintained by local authorities in England and Wales and 84 in Scotland, the numbers had fallen to 459 and 65 respectively by 1963.

Nursery schools. The nursery school is another useful agent for the care and supervision of two to five year olds. The prototype of this institution as a separate entity is to be found in Owen's work at New Lanark and the Dame Schools, which flourished especially during the nineteenth century. In 1854, the work of Froebel and his kindergarten movement was introduced into Britain and this considerably influenced the growth of infant schools and the nursery school in its modern form. Froebel regarded the kindergarten as a supplement to home training and in no sense a substitute. His ideas were popularised by Charles Dickens, and the first of the modern-type nursery school was opened at Salford in 1873. Nursery schools were first recommended in Britain in 1908 by the Consultative Committee of the Board of Education and a beginning was made on a voluntary basis with small nursery schools in slum areas, followed by the establishment by Margaret McMillan in 1911 of a large open-air nursery school at Deptford. No legal or administrative action was taken to carry out the recommendations of the 1908 Report until the passing of the Education Acts, 1918, for England and Scotland respectively, when legislative powers to supply or aid the supply of nursery schools were granted for the first time to education authorities. The work of Dr. Maria Montessori greatly influenced nursery school development, especially in the matter of equipment, including furniture and play material. The Nursery School Association (now the Nursery School Association of Great Britain) was founded in 1923 and has done much to further the nursery school movement. During the 1939–45 war there was no expansion of nursery school provision, but the Education Acts, 1944 and 1962 (Scot.) recognised the need for further provision but little has yet been achieved in this direction.

Nursery classes. In 1931, the Chief Medical Officer to the Board of Education described a nursery class as a less intensive form of nursery school, similarly staffed but conducted, not as an autonomous organisation but as part of the ordinary infants' division of the elementary school. Nowadays, the distinctions between a nursery school and a nursery class are only those of administration and age of pupil, the nursery class usually only admitting children between the ages of three and five years. Nursery classes were considerably extended during the 1939–45 war and many were open for twelve hours daily, and full government grant was given for them.

Toddlers' playgrounds. These organisations were pioneered in Edinburgh for pre-school children. The playgrounds were the direct result of visits in the homes by health visitors from a local voluntary organisation. In 1914, in order to judge the value of the home visits, this association organised an intensive visitation of some 400 homes in districts where conditions were known to be bad. The results of this visitation were summarised as follows: 'Practically every baby was clean; the majority had separate cots, and nearly all windows were open. But the ex-baby, the toddler, sat on the fender or on the stairs, or sometimes in the street, often unwashed, listless, flabby, with nothing to do.' It was evident that something less deliberately educational than nursery schools and more definitely for health *per se* was urgently required. The first toddlers' playground was, therefore, opened in 1915 with the object of providing opportunity for exercise, fresh air, and happy occupation for children living in the crowded parts of the city. Since this initial effort, the number of playgrounds in Edinburgh has increased to 29 in 1964 with some 943 children attending for two hours each morning during school days.

Welfare foods. To safeguard the nutrition of pregnant women and children under five, a National Milk Scheme was introduced by the Ministry of Food in 1940. Under this scheme, these two classes of the community were entitled to receive one pint of milk daily, free or at a reduced rate. Later the same year, a national full-cream dried milk was made available for infants under one year for whom liquid milk was unsuitable and in 1941, a national half-cream dried milk was produced. In 1941, also, a vitamin scheme was launched to provide pregnant women and children under two with fruit juices and a cod-liver oil compound. Towards the end of that year, concentrated orange juice became the chosen source of vitamin C under lease-lend arrangements. The milk and vitamin schemes were merged in 1942, and the vitamin supplements were extended to all children under five. In 1943, pregnant women were supplied with fish-liver oil capsules or vitamin A and D tablets instead of the cod-liver oil compound which was distasteful to many. Later, only the tablets were supplied. Following a report by the British Paediatric Association (1944) the Ministry of Food began the issue of vitamin D fortified national dried milk. When the family allowances scheme was introduced in 1946, the milk and vitamin scheme became associated with it and was renamed the Welfare Foods Scheme. In 1954 the distribution of welfare foods, other than liquid milk, passed from the Ministry of Food to local health authorities. Following the recommendations of the Joint Sub-Committee on Welfare Foods (1957) and accepted by government, the issue of orange juice concentrate was restricted to children under two years, and the vitamin D content of national dried milk and cod liver oil compound was reduced. In 1961 the bulk purchase of welfare foods passed from the Ministry of Agriculture, Fisheries and Food to the Ministry of Health, and in June of the same year changes were made in the conditions of issue of the vitamin supplements. Thus the special tokens were required only for liquid and national dried milk, while cod liver oil compound, concentrated orange juice and vitamin tablets (for expectant and nursing mothers) became purchasable at cost price and without surrender of tokens. Cod liver oil compound and concentrated orange juice became purchasable for children up to five years, and longer if they were handicapped. The present vitamin content of the welfare foods is: national dried milk, full and half-cream varieties, 50 i.u. vitamin D as a minimum, with an average content of 100 i.u. per 1 oz. of powder; cod liver oil compound, 3,000 i.u. vitamin A and 400 i.u. vitamin D in each fluid drachm; concentrated orange juice, not less than 60 mg. ascorbic acid per 1 fl. oz. of concentrate; each vitamin tablet, 4,000 i.u. vitamin A, 800 i.u. vitamin D, 250 mg. dibasic calcium phosphate, and 0·13 mg. of potassium iodide, B.P. Arneil (1964) is critical of the present cod liver oil compound and advocates a more palatable and attractively marketed product through the welfare foods scheme.

Summary. The Child Welfare Service has therefore developed from: (*a*) efforts to improve midwifery practice and to provide antenatal care; (*b*) concern over the ravages of gastro-enteritis and attempts to halt them by infant consultations, provision of clean milk, vitamin supplements, and meals for mothers to help to encourage breast feeding; (*c*) health visiting in the homes to instruct mothers in infant and child care; (*d*) extension of such services as are applicable for the benefit of pre-school children. Protection of the child from exploitation and abuse largely developed along with these measures, but recent legislation has transferred the responsibilities for this supervision to children's departments of local authorities.

Infant Welfare in Other Countries

France. It has already been seen that France was a pioneer in providing day nurseries. Towards the end of the nineteenth century she was also perturbed by her high infant mortality and falling birth rate. The remarkable results achieved by the de Villiers, father and son, at Villiers-le-Duc showed what could be done by properly applied preventive measures. In 1890, Herrgott founded *L'Oeuvre de la maternité* at Nancy where infants born at the hospital were brought up for medical examination a month after birth, a small sum of money being given to each mother if her infant's condition was satisfactory. In 1892, Pierre Budin established the first *Consultation des Nourrissons* at the Charité, Paris. These 'consultations' were either developed at maternity hospitals in order to supervise children born at the institutions or were organised as independent centres available for any infants to be brought by their mothers. The infants were regularly weighed, the importance of breast feeding emphasised, and if absolutely necessary sterilised milk was supplied for the artificially fed. The *Gouttes de Lait* founded by Gaston Variot (1893) and Léon Dufour (1894) were primarily for infants who could not be breast-fed, though breast feeding was encouraged where possible. The milk depots supplied pure milk in suitable dilutions and quantities, all children attending them were subject to systematic medical supervision, and often the milk was only supplied on condition that the child was brought regularly for medical examination.

Today, each department has a full-time director of health who is responsible for the provision of adequate child welfare services, including health visitors (*assistantes sociales*). In Paris, much of the child welfare service is provided by the *Assistance Publique*, and at some of the clinics there, sterilised and modified milk feeds are still issued in bottles with coloured tin-foil caps which identify the different mixtures. The benefit of these prepared feeds is considerable in the older housing areas of Paris on account of the lack of adequate water supplies.

United States of America. In America, the development of the Infant Welfare Clinic (the Well Baby Conference) was largely due, in the first instance, to the efforts of the milk reformers who, in the last decade of the nineteenth century, were divided into the advocates of the 'certified' milk movement, founded by Dr. H. L. Coit, and those who supported compulsory pasteurisation of all milk supplies. Of the latter group, a leader was Nathan Straus of New York, a philanthropist who realised that the high infant mortality in that city was largely due to gastro-intestinal disease. With the encouragement of Abraham Jacobi, one of the first American paediatricians, Straus opened a milk depot in one of the poorer parts of New York in 1893. Pasteurised milk was issued, both diluted and undiluted, for infant feeding. By 1902, there were 14 such depots in New York and the development of the service was so rapid as soon to be beyond the limits of private philanthropy. In 1913, 77 depots were operating in the city, two-thirds being provided by the municipality.

Meantime, in 1908, a municipal Bureau of Child Hygiene had been established in New York, the first in the country. In 1909, a conference on the prevention of infant mortality was convened by the American Academy of Medicine, out of which developed the American Child Hygiene Association which, in 1922, fused with another voluntary body, the Child Hygiene Association of America, to form the American Child Health Association. A Federal Children's Bureau was founded in 1912 and after legislation passed in 1921 there was a rapid development of State Bureaux of Child Hygiene. In 1935, the Social Security Act gave a fresh impetus to the child welfare movement in America. Thus, today, there is the Federal Children's Bureau with advisory, co-ordinating and research functions, and State and local (county and city) child health services. Health visiting is carried out by public health nurses who combine curative with preventive nursing duties. Private physicians take a prominent part in the preventive paediatric services and voluntary organisations assume much responsibility. Yet, in 1958, it was estimated that 10 per cent of the American population was still without adequate local health units. These were mainly in rural areas (Haldeman and Flook, 1959).

New Zealand. The development of child welfare services in this country is inseparably associated with the name of Truby King. Impressed by the considerable wastage of infant life, yet by contemporary standards a moderate wastage, he was instrumental in founding, in 1907, the New Zealand Society for the Health of Women and Children, given a Royal Charter in 1915, and now conveniently known as the Plunket Society. Truby King was prominent in obtaining legislative measures for the early notification of births and of improving conditions for babies boarded-out under the State. The Society is a voluntary organisation, subsidised by the State, and considered an integral part of the National Health Service of New Zealand. The Society undertakes the provision of a national service of health visitors (Plunket nurses) who are also trained by the Society, though infant welfare work among the Maori population is carried out directly by the State Department of Health; of child welfare clinics, both static and mobile; of mothercraft teaching at these centres; of courses of training for nursery nurses (Karitane nurses). The health services of New Zealand resemble in many ways those obtaining in Britain, but are divided into twelve divisions, each with its own Director who is responsible to the Governmental Director-General for the administration of each division. In 1959 a consultative committee on infant and pre-school health services recommended (Finlay Report), *inter alia*, that a child health council should be established to regulate all agencies in the field of child health, that the Plunket Society continue to provide Plunket and Karitane nurses, and that a chair of child health be set up at Otago Medical School.

International Children's Centre. This centre, established at the Chateau de Longchamp, Paris, in 1950, was the result of a suggestion made by the French Government to UNICEF. The centre exists for the study of all new developments affecting the welfare of children, to disseminate information about such developments, to assist in their practical application throughout the world, and to give assistance and advice to paediatricians, social workers and others when visiting foreign countries on study tours. Its first director-general was Professor Robert Debré.

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Chapter 12

THE INFANT AND PRE-SCHOOL CHILD HEALTH SERVICES

THE National Health Service Acts resulted in a reorganisation of the medical services of the United Kingdom. This reorganisation was only a part of the great social revolution following on World War II. Voluntary bodies, both local and national, have always played a large part in making provision for the care of the young child, and in the present child health service both voluntary and statutory organisations form the framework. The aim of the service is the integration of all fields of endeavour, both in the curative and preventive fields, and it is inseparably associated with the maternity service. It is now recognised that child life begins at conception and not merely at birth, so that preventive paediatrics begins with the promotion of healthy motherhood, and then with the study of the child in the family circle. The medical facilities now provided are shared by three statutory bodies.

Regional Hospital Boards. These boards provide a hospital service, which includes outpatient departments, as well as convalescent home facilities. In addition, a consultant service for hospital and domiciliary care is provided. There are fourteen regions in England and Wales and five in Scotland. All save one—the northern region of Scotland—include the medical school of a university, on which the consultant and hospital service is based. There is thus opportunity for close association of hospital paediatric staffs and child welfare medical officers of local health authorities.

Local Executive Councils. A medical practitioner service is provided by these councils, as well as dental, pharmaceutical, and supplementary ophthalmic services. General practitioners may be employed by local health authorities on a sessional basis for child welfare clinics. Other general practitioners who conduct child welfare clinics at their own surgeries or at health centres may receive the assistance of health visitors from the local health authority. All doctors may provide domiciliary maternity services for women on their own lists, and such doctors work closely with the midwives employed by local health authorities. In addition, in the area of each local executive council in England and Wales there is a local obstetrics committee which keeps a list of local practitioners specially experienced in midwifery (general practitioner obstetricians) and who are prepared to respond to any emergency calls by midwives.

Local Health Authorities. Each local health authority must provide a health visitor service, the functions of such health visitors to include the giving of advice as to the care of young children, expectant and nursing mothers, and as to measures to promote health and prevent the spread of infection. In addition, the local health authority must 'make arrangements for the care, including in particular dental care, of expectant and nursing mothers and of children who have not attained the age of five years and are not attending primary schools maintained by a local education authority'. The local health authority is the local welfare authority to which notifications of birth are made. The extent and scope of a local health authority's service concerning the infant and pre-school child depend on the nature and needs of the area to be served. The administration of maternal and child services was recently the subject of a Special Report of the World Health Organisation (1957). The following may constitute part of such a service.

Health Visiting

Since the health visitor cannot enter the house unless the occupant is willing, it is essential that she carry out her home visitations with tact, letting it be known that her object is to help and not to pry. The medical officer of health receives the statutory notification of all births which occur in his area, and his health visitors carry out home visiting as soon as each mother and infant are discharged from hospital, or when the midwife ceases to attend. Thus the closest association must exist with maternity hospital, medical practitioner, midwife and health visitor. Continuity of care of the mother and her infant is essential in dealing with such matters as breast feeding, general management and hygiene of the infant, and other personal matters on which a mother can best be advised by a health visitor. At the health visitor's first postnatal visit the mother is invited to bring her infant to the local infant welfare centre. Home visitation is the pivot round which a local health authority's child welfare service revolves and it should continue until the child enters school. In most areas the health visitor is responsible for both the pre-school and school-age periods, and so continuity of care is assured. In other instances where the child welfare and school health services are separate, the closest contact must be maintained and arrangements made for the transfer of records and information. Since the health visiting service has also suffered from the general nursing shortage, selective home visiting is widely adopted. Thus families are graded according to their needs, and difficult and problem families are visited with greater frequency than normal families who have a fuller appreciation of their obligations. The health visitor, by reason of her close contact with families with young children, is particularly well placed to recognise early signs of failure in the family which may lead to disruption of normal home life. From her training, experience, and her contacts with other statutory and voluntary agencies in the field of family welfare, she is in a position to give advice which will frequently enable the family to overcome its difficulties. Under the Children and Young Persons Act, 1963, the children committee of a local authority is required 'to make available such advice, guidance and assistance as may promote the welfare of children. . . .' Consequently, a particularly close bond must be forged between the health visitor and the child care officer of the local children's department.

Other recent developments in the health visiting service include the entry, after appropriate training, of the health visitor into the fields of mental health affecting both child and adult, and of early diagnosis of handicapping conditions. Thus, testing for phenylketonuria, screening for deafness and regular supervision of children 'at risk' to handicap have become regular duties for her. Following the early diagnosis of a handicap in infancy and childhood the health visitor in concert with the family doctor can do much to help and encourage the parents of such children by creating a favourable atmosphere in the home. The closer association of health visitor and family doctor has been advanced by the increasing number of local health authorities which have allocated full-time health visitors to practices, usually group practices, a step pioneered at Oxford and in Hampshire. Considerable success has attended this measure, especially with the increasing interest of family doctors in the child welfare aspect of their work. It is evident, therefore, that the health visitor, in addition to her close association with midwives, home nurses, and medical practitioners, must also work harmoniously with medical social, psychiatric social and family case workers as well as with child care officers and others in the field of medico-social service.

Two other and recent problems face the health visitor. The first is the reappearance of rickets both in immigrant and white children in this country (Benson *et al.*, 1963; Arneil, 1964) and this emphasises the urgent need for more intensive and continued health supervision of young children and the better education of their mothers on health matters. The second is the need for advice and help for the immigrant population of Great Britain. There is a real urgency about this and there must be greater opportunities afforded to health visitors, social workers and others to learn something of race relations, cultures, and the difficulties facing immigrants. In many areas there are voluntary committees and specially appointed officers who are knowledgeable and experienced in the field of social and health work among immigrants (Peppard, 1964). Gans (1964) stressed the value of the health visitor working in a district with a high immigrant population and recommended that more coloured health visitors should be employed in areas where the coloured population was high.

Home Nursing

The National Health Service Acts require local health authorities to provide a nursing service for those, including infants and young children, who require nursing in their own homes. Gillet (1954) pioneered a special children's home nursing unit at Rotherham in 1949, and experimental schemes have been conducted by Birmingham Corporation in association with the Birmingham Institute of Child Health and Children's Hospital (1954), and by St. Mary's Hospital, Paddington (Davis, 1958; McClure, 1960). The home nursing service of this latter scheme has now been absorbed into London County Council's service (1959). These schemes have served to emphasise the need for the closest association between family doctor and local authority services with the help, as necessary, of hospital and specialist services. The Committee on the Welfare of Children in Hospital (1959) recommended an extension of special nursing facilities for the sick child at home. It also recommended that when a child required admission to hospital, the health visitor should help the mother to prepare the child for his admission, and to receive him at home after discharge.

Domiciliary Care of the Premature Infant

The World Health Organisation Report (1961) on the public health aspects of low birth-weight and the studies of McDonald (1963) and Drillien (1964) on the subsequent growth and development of premature infants of low birth-weight have served to focus attention on the early management of prematures. This was the subject of an important report by a sub-committee of the Central Health

Services Council (1961). Some local health authorities provide a particular service for the domiciliary care of these infants including facilities for immediate resuscitation, the loan of special equipment, feeding bottles, mucus extractors, etc., as well as the attendance of midwives or health visitors specially trained in the care of premature babies and capable of teaching the mothers the special care required. For infants needing transfer to hospital specially equipped ambulances or cars are used, and, where possible, the mother is admitted to hospital along with her infant. The closest liaison must exist between hospital, family doctor and local health authority on such matters as discharge home of the infants and the need for their continued supervision by doctor, midwife or health visitor. Breast milk banks may be maintained by hospitals or local health authorities for the supply of breast milk for premature infants born in hospital or at home. Since premature infants, especially those of low birth-weight, come under the category of infants 'at risk' to handicapping conditions, efficient long term follow-up by paediatricians or medical officers trained in developmental assessment is paramount.

Protective Inoculations

In 1961 the Ministry of Health and the Scottish Home and Health Department issued circulars advising the use of either of alternative programmes for the immunisations of childhood incorporating the use of triple vaccine as the prophylactic of choice against diphtheria, tetanus and whooping cough, and inactivated virus vaccine (Salk) against poliomyelitis. The following year live poliomyelitis virus vaccine (Sabin) administered orally was introduced and rapidly superseded the inactivated vaccine. Consequently the two schedules were amended, substituting the live for the inactivated poliomyelitis vaccine. The amended schedules also recommended that vaccination against smallpox should be performed sometime before the age of two years, preferably during the second year. This advice, superseding the previous traditional practice of vaccinating a healthy infant before the age of six months, was based on data collected over a number of years which showed that the incidence of the complications of vaccination against smallpox, though small, was higher in the first year of life than in the subsequent years of early childhood.

The Central and Scottish Health Services Councils in 1963 appointed a Joint Committee to advise the Health Ministers on all medical aspects of vaccination and immunisation. One of the first tasks of the new Committee was to enquire into the suggestion made by Dick (1962) that routine vaccination against smallpox in infancy was unnecessary. The Committee, however, concluded that there was no justification for altering the existing policy of routine vaccination, as modified (*supra*), and suggested that revaccination during school life should be encouraged. Other problems concerned with immunisation procedures which are presently occupying the Committee include: the use of quadruple vaccine, *i.e.* a vaccine containing diphtheria, tetanus, whooping cough and inactivated poliomyelitis antigens; the concurrent administration of triple vaccine and oral poliomyelitis virus vaccine; the production of a measles vaccine and the conduct of trials in its use by the Medical Research Council; the effective prevention of tetanus; an investigation into the benefits and dangers of whooping cough vaccination; and the production and use of an effective influenza vaccine.

It is important that parents should be properly informed of the inoculations given to their children and the diseases against which these measures are designed to protect. No official personal record card of inoculations exists, but one such as some commercial firms provide should be handed to a parent by the family doctor or at the clinic, and each inoculation entered in the card when given to the child, as well as being entered into the appropriate record form required to be returned to the local health authority on completion of each inoculation course. The Ministry of Health in 1961 introduced record cards on which notes of inoculations given by medical practitioners to Health Service patients could be entered, this forming part of the *medical* record of every N.H.S. patient. Health visitors should also keep a careful note of the immunisation histories of all young children in their districts.

Syringes and needles used for inoculations should be either of the disposable variety, carefully discarded after each injection, or from a sterile syringe service, so that a freshly sterilised and processed syringe and needle are used for each injection.

Local health authorities also make arrangements for BCG vaccination of susceptible (tuberculin-negative) young children who are contacts of known cases of tuberculosis, and the newborn infants of tuberculous mothers. Newborns may be vaccinated in the maternity hospital or admitted for the purpose to residential homes provided by the local health authority. Older children may be vaccinated at chest clinics and, if home conditions are unfavourable, temporarily boarded-out with foster-parents until immunity develops. Some of these children may not be able to return home after converting to a positive skin test owing to adverse home conditions and so must remain with their foster-parents until circumstances improve. Such boarding-out arrangements are usually made by the medical officer of health in consultation with the children's officer, the family doctor concerned being kept fully informed of all developments. Special record cards are kept for BCG vaccinations but general practitioners are precluded from using BCG vaccine in contradistinction to other prophylactics.

Since no form of immunisation or vaccination is compulsory, constant endeavour must be made by health visitors and doctors to persuade parents to have their children protected. Constant propaganda by talks, newspaper and magazine articles, leaflets, films, posters and the like is required to keep the need for protection constantly before parents.

Child Welfare Centres

The size and staff of a child welfare centre depend upon local circumstances, and whilst in sparsely populated rural areas it may be only possible to hold a session once a week or even less frequently, in a borrowed building, in urban areas it is desirable to have a specially constructed building and to have the centre open frequently. Mobile clinics are used by some local health authorities for use in rural areas and in outlying housing estates of towns and cities. Criticism has frequently been directed at the unsuitability and unattractiveness of some centres. Many are church halls and similar premises, some are buildings adapted for the purpose, and others are specially built centres. Wherever the centre is, however, the premises must be clean, as attractive as possible, adequately heated, ventilated and lighted, and a friendly, helpful atmosphere must pervade so that mothers will be encouraged to bring their infants and young children to the centre.

The centre must be centrally situated in the area it is designed to serve. The approaches must be good and access to the centre easy. The minimum requirements for any centre are: a pram-shed or other suitable covered parking place, a waiting room which may also serve for weighing and measuring the infants, but it is desirable to have separate accommodation for these two procedures, a consultation room, suitable facilities for storage of case-records, for welfare foods, dried milks and simple medicaments, and proper sanitary facilities. In planning the layout of a centre, as a separate entity, as part of a combined child welfare and school health centre, or as part of a health centre, provision should be made for the following:

GENERAL. If the centre is a combined one or part of a health centre, the entire child welfare section should be on ground-floor level.

OUTSIDE. A covered pram-park. Sufficient open space for toddlers to play in and where infants may be parked in their prams and kept under supervision while a mothercraft or other meeting is being held.

INSIDE. (1) A comfortably furnished waiting-room of reasonable size in which, at other times, health talks, demonstrations and film shows may be given.

(2) A kitchen adjoining for use for cookery demonstrations and for preparing teas if this is a practice at the centre.

(3) An undressing room where the infants and young children may be weighed and measured. Facilities are required in this room for storing baskets or other receptacles for the children's clothing.

(4) Consultation room equipped for child welfare consultations, and if antenatal work is also carried out at the centre, with adjacent cubicles.

(5) A breast-feeding room.

(6) An isolation room for suspected cases of infectious disease awaiting examination or disposal, and preferably with direct access to the outside.

(7) Accommodation for the storage and distribution of welfare foods, dried milks and simple medicaments.

(8) Staff room.

(9) Sanitary accommodation for staff and patients.

(10) Dental surgery.

(11) Recovery room.

(12) Dental waiting room.

STAFF. Medical sessions at child welfare centres are held at stated times, usually in the afternoons and sometimes in the forenoons. Gans (1964) has shown the value of evening sessions for the children of immigrant working mothers and the importance of the attendance at these sessions of the health visitors of the district in which the clinic is situated. The medical staff may be general practitioners engaged on a sessional basis, registrars from children's hospitals, or full-time medical officers of the local health authority. In some areas, these full-time medical officers combine both child welfare and school health work but where this is not the case, arrangements should be made for the interchange of medical officers so that they may gain experience in both branches of child care and so establish a co-operative spirit between these two services of a local authority.

The nursing staff consists of one or more health visitors whose districts the centre serves. These health visitors will be in attendance during the medical sessions at which mothers and young children for whose home visiting they are responsible are due to attend. In some instances a large centre serving a wide area may be open daily and be in charge of a senior health visitor who will be in attendance each day for advising mothers and arranging appointments for the medical sessions. Sometimes health visitor sessions are held at stated times other than those when medical sessions are held.

A dental officer and attendant, usually from the school dental service, may be present daily or on a sessional basis if the centre is equipped with dental facilities. Dental care is a priority service which local health authorities must offer for the benefit of pre-school children, and so suitable arrangements must be made for this service to be readily available.

Clerical assistants are required for keeping attendance registers and filing case-records, for distributing welfare foods, and for the preparation of teas. Sometimes voluntary helpers assist in or undertake these duties, but any medicines given are only issued by the health visitor on the instructions of the medical officer.

The work of the child welfare centre. This is essentially advisory, diagnostic and educational, but the centre does not supply the answer to all the problems of infant and child care. The prevention of home accidents and of the occurrence of problem families can only be tackled adequately by the health visitor in her home visiting when she is aware of the conditions obtaining in the home. Consequently, the child welfare centre must be kept in proper perspective and not allowed to obscure or take the place of home visiting.

Each infant is seen by the medical officer when brought to the centre for the first time. Thereafter, less frequent though more detailed routine medical supervision is undertaken and this tendency has taken the place of the doctor seeing each mother and her infant weekly as was formerly the accepted practice. Frequency of attendance depends upon the progress made by the infant but it is desirable that the doctor or health visitor should arrange the date of the next visit rather than leaving this to the mother's discretion. During the early weeks of life one of the important advisory functions of the centre is to encourage breast feeding and much of the work of the medical officer and health visitor is directed to this end. Facilities should, wherever possible, be made available at the centre for a mother to attend for test-weighing of her infant and to receive help and advice from the health visitor concerned with the supervision of mother and infant. Advice is also given at the centre on suitable artificial feeds when these are required. The weaning period is a time, too, when detailed advice on diet is especially required and the mother should be encouraged to attend weekly with her infant so that she may be given the necessary advice in simple stages and the infant's reactions to the new foods assessed.

Attendance of infants up to one year of age at centres is generally good, but thereafter as the child gets older there is an appreciable decline in attendances. To overcome this obvious deficiency during a period when continued supervision is so important, special toddler sessions are usually held when one- to five-year-olds are brought to the centre every three to six months, by appointment, for medical examination and discussion between mother and doctor on matters concerning nutrition, posture, foot health, character training, mental and emotional development and their relation to the general conduct and welfare of the home. Pasi and McHugh (1964) present the concept of a health and development clinic for pre-school children. Better appreciation of the importance of mental and emotional factors is reflected in the increasing association between those working in the child welfare and psychiatric fields. Some authorities have appointed child psychiatrists to help clinic staffs. Such a consultant may advise mothers directly or more usually he holds case conferences with the medical and health visiting staffs and discusses their cases with them giving guidance and advice as to how to deal with each problem.

The supervision and assessment of infants and children 'at risk' to handicap is an important function of the clinic, and special sessions are usually held for such children, a paediatrician or medical officer experienced in developmental diagnosis seeing each child. Thus the early detection of abnormalities and the prompt referral of cases through their general practitioners for the appropriate treatment and care are essential. Actual treatment at the centre is limited to minor conditions only, such as napkin rashes, all other cases being referred to the general practitioner. Some authorities provide facilities at larger centres for the attendance at consultative sessions of paediatricians, orthopaedic surgeons and other specialists to whom cases may be referred by the centre medical officers for advice. Sometimes special clinics are held for the examination of children prior to their placing for adoption. Classes for remedial exercises for toddlers, and conducted by physiotherapists, and chiropody sessions may also be offered at some centres.

Case-records are important. A case-sheet including a record of the weight, height, feeding, results of examinations and other clinical notes is kept at the centre for each child attending, and a summary from this case-sheet is forwarded to the school health service when the child passes over to its care. The mother, when she first brings her child to the centre, is given a handy-size weight card which is entered up at each attendance and on which the date of the next visit to the centre is inserted.

Educational activities constitute the third of the functions of the centre. Not only is individual teaching of mothers carried out by medical officers and health visitors during consultations, but group teaching is also undertaken. Thus, short talks may be given by a health visitor to small groups of mothers in the waiting-room during ordinary sessions. Series of weekly or fortnightly meetings may be arranged by the senior health visitor of the centre at which talks, films, and demonstrations are given on subjects ranging from breast feeding, protective inoculations, accident prevention, sleep, common infections and behaviour problems to cookery and practical garment making. Some of these meetings may be held in the evenings, when fathers can act as baby-sitters at home. At the more progressive centres discussion groups for fathers are also conducted by the medical officer of health or one of his male assistants. For talks, free use should be made of the blackboard, charts, film-strips and flannel graphs.

Distribution of cod-liver oil compound, concentrated orange juice, and national dried milk under the Welfare Foods Scheme is usually undertaken at child welfare centres. Many family doctors are organising special child welfare sessions at their surgeries and a health visitor may, if the doctor so desires, attend and assist him then. This admirable development deserves every encouragement.

Day Care of the Pre-School Child

The present is a period of considerable experiment in various forms of day care for young children. In 1945, joint circulars issued by the Ministries of Health and Education and by the then Department of Health for Scotland and the Scottish Education Department to local authorities intimated that the war-time nursery scheme would terminate the following year. The circulars offered guidance to local authorities in planning their provision for the group care of under-fives, recognising that a modified day nursery service would require to be provided by some local health authorities. The same circulars stated that some permanent provision might need to be made for the occasional care of all children up to five years, in order that mothers, whether or not they required to go out to work, might have a reasonable opportunity of rest and relaxation apart from their homes and children. In recent years there has been, on the part of parents and of voluntary societies, an increasing interest in forms of nursery care precipitated by the progressive closure of local authority day nurseries as an economy measure and the virtual cessation of nursery school expansion. The type of provision made for such care has been determined by the needs of the children in a particular area. Their home backgrounds vary greatly and this is reflected in the variety of group activities now in operation designed to help the mother and supplement the home by meeting the needs of the children whatever they may be. For some children the most urgent need is for the companionship of other children of the same age, for others, *e.g.* those living in high flats, space in which to play safely and in freedom but under supervision, and for others, a daily period in the care of persons who understand the needs of young children and whose relationship with the children is likely to be more detached than the parental one. Thus we have voluntary organisations, *e.g.* Save the Children Fund and The Pre-School Playgroup Association (founded 1962), both of which organise and help with the promotion of nursery groups. In addition to these there are many other local organisations which assist in the provision of such groups for pre-school children.

Over the years considerable controversy has raged on the place and value of day nurseries, nursery schools and classes, and other forms of day care for young children. The upset to the child from separation from his mother, the relieving of the mother of her responsibilities to her child, the greater risk of infection, and in the case of local authority day nurseries and nursery schools the heavy cost of their provision have all brought criticism from many quarters. On the other hand, all forms of properly supervised day care have a positive value. The children attending them are given a sense of security and communal living, freedom and a friendly, firm, but unobtrusive control exerted by the staffs who understand and respond to the children's needs. Day nurseries in particular were never intended to cater for the mass of young children. Indeed, their role has always been a modest one. But day nurseries are required for a small proportion of young children—those of single or separated parents, those from families where the mother must work because of the father's disability, and those from homes where the mother is ill or in hospital, or where the home conditions are unsatisfactory. The children of harassed mothers, of young couples both of whom must work to obtain and maintain a new home, and children requiring supervision and care for physical, emotional or psychological disturbance, may be cited as other suitable candidates for day nursery care. The period of stay at the nursery will obviously depend on the circumstances surrounding each child. Because of a realisation of the medico-social grounds demanding day nursery provision, progressive local health authorities have evolved systems of priority for admission largely based on the above types of case.

The various forms of group day care may be classified as follows:

DAY NURSERIES. The National Health Service Acts 1946 (Eng. and Wales) and 1947 (Scot.) gave powers to local health authorities to provide or to aid the provision of day nurseries and permitted a charge to be made for meals or food supplied at the nurseries only. Amending legislation (1952) empowered authorities to make a comprehensive charge for all the services provided at day nurseries. While the general policy is to discourage mothers of infants to go out to work there is often the necessity for mothers to do so, *e.g.* unmarried mothers and widows. Recommendations concerning day nurseries, whether provided by local health authorities or privately administered, have been issued from the Ministry of Health and Scottish Home and Health Department (formerly Department of Health for Scotland). The following is based on these recommendations.

Location. A day nursery should be situated as centrally as possible in the area it is designed to serve.

Premises. The number of children in a nursery should not normally exceed 40 to 50, but as an economy measure larger nurseries may be planned, designed to accommodate several such groups cared for quite separately but making use of communal staff rooms, kitchen and laundry. Ordinary nursery premises should include:

(1) Three nurseries (infants, tweenies, toddlers) allowing 40 sq. ft. per child under one year, not less than 30 sq. ft. in nurseries for tweenies, and 25 sq. ft. for each child over two years.

(2) Suitable provision for receiving the children and for keeping their clothes. Bathing facilities are required. Separate sanitary annexes for tweenies and toddlers near their respective nurseries. Three wash-hand basins for every ten children and one lavatory for every six children over two years. Storage facilities for chamber pots.

(3) Kitchen, scullery, larder, and dry store room.

(4) Milk larder and refrigerator, with provision for preparation of bottle feeds.

(5) Adequate laundry and drying facilities. Separate boiler for napkins and covered sterilizable containers for soiled garments. Larger items sent to outside laundry.

(6) Sufficient pure water supply, and adequate hot water supply.

(7) Dining and sitting room for staff, with study room if a training nursery. Sanitary and adequate hand-washing facilities. To remind staff of the importance of hand hygiene after use of the toilet, notices should be put up in the toilets with the caption 'Now wash your hands'.

(8) An isolation room.

(9) Matron's office which can be used for medical examinations and parent interviews.

(10) Linen room and airing cupboard.

(11) Housemaid's cupboard.

(12) Washing-up pantry.

(13) Suitable pram storage.

Dish-washing machines may be used, otherwise the equipment for dish-washing must conform to the Food Hygiene Regulations.

Central heating is advantageous, but whatever form of heating is used, fixed fireguards or radiator guards must be provided. Sub-floor heating has many advocates because it requires no guards and spreads the heat evenly. Proper means of fire-escape are essential. A garden play-space and a hard-surface playground for dry and wet weather respectively, and protection from hot sun should also be provided.

Staff. The matron must be trained and experienced in the care of healthy children. She may be a state registered nurse or certificated nursery nurse previously experienced as a deputy matron. In a training nursery, the matron must have teaching ability. A warden or play-mistress is required if the nursery caters for two- to five-year-olds. The remainder of the staff consists of: a deputy matron, who should be a certificated nursery nurse of at least two years' experience since qualification, certificated nursery nurses, nursery assistants, and nursery nurse trainees if the nursery is a training establishment recognised by the National Nursery Examination Board or the Scottish Nursery Nurses Examination Board. Exclusive of domestic staff, the ratio of full-time staff to children must not be less than 1:5, three students in training being regarded as equivalent to one full-time member of staff. The domestic staff should include an experienced cook and a sufficient number of full-time or part-time workers.

The nursery staff, by their friendly attitude should seek to establish cordial relations with both children and parents. They should be able to help the children's own mental development without undue interference and, while recognising the children's limitations, to give the necessary help when required. They should be able to provide or improvise materials and stimulus for the children's growing mental needs. The children's well-being is provided for through proper feeding arrangements, adequately regulated warmth, clothing and activity, a high standard of cleanliness in kitchen, bathroom and playroom, and an understanding of their needs for fresh air, outdoor play and proper ventilation.

Daily Nursery Routine. Briefly, the nursery day includes time for play both indoors and out of doors; for music, rhymes, stories and games; for washing, and use of lavatories without hurry or crowding; for informal and more formal meals; and for sleep, rest, and quietness.

Staff Contacts with Parents. Regular contact with parents is essential and the matron or her deputy should personally receive each child daily from the parent and hand him over again in the evening. Mothers' meetings or clubs organised in connection with the nursery are valuable in that instruction, help and advice may be offered to the mothers and discussion take place on matters pertaining to child health and welfare. Fathers may also be interested in the nursery, and their help enlisted to make and repair equipment and toys.

Health Measures. All children must be medically examined on admission to the nursery and at regular intervals thereafter, records of each child being kept. Such examinations are usually undertaken by medical officers of the local health department and these officers visit the nurseries frequently, *e.g.* once weekly. For emergencies, arrangements may be made for the services of a neighbouring general practitioner. Any child thought to be suffering from an infectious disease should be excluded from the nursery, or isolated there until seen by the doctor. Hence the importance of the matron or her deputy receiving each child in the morning and knowing where the parent may be found during the day. The diet for the children must be adequate and suitable, including the full allowance of milk and supplementary vitamin preparations as provided under the national scheme. It is also useful to display the week's menu in the nursery entrance hall so that parents may see the type of diet given to the children. Arrangements for the midday rest are also necessary by the provision of stretcher beds and blankets. The health of the staff, both nursing and domestic, requires supervision and all members of staff should be examined at least yearly by mass miniature radiography.

PRIVATE DAY NURSERIES, CHILD-MINDERS, AND DAILY GUARDIANS. Private day nurseries, run by factories and by individuals, must be registered and inspected by local health authorities under the Nurseries and Child-Minders Regulation Act, 1948. Child-minders, who must also be registered, are persons, other than relatives, who take into their own homes for reward more than two children under five years of age and from different households, and look after them for the day or part of the day. Some local health authorities maintain a system of registration of daily guardians. These guardians are women who take into their own homes for reward, one or two children under five and look after them for the day or part of it. They voluntarily register with the authority which grants them a small weekly fee in return for which they are subject to inspection by the authority. There has been a considerable increase over the years in the number of private nurseries and child-minders. In 1951 there were 339 private nurseries and 468 child-minders registered in England and Wales, while in 1964 these had increased to 1,585 and 2,994 respectively.

NURSERY SCHOOLS AND CLASSES. These are described in Chapter 13 on the School Health Service.

TODDLERS' PLAY-CENTRES. Reference has already been made to these organisations in Edinburgh. The aims and objects of the play-centres are to provide for the health and well-being of toddlers, aged two to five years, who live in the poorer and more crowded parts of the city as well as those living under better conditions, *e.g.* high flats, etc., but where opportunity for the necessary exercise and supervision is lacking, and to relieve the ordinary overburdened mother to get on with her housework, shopping, or may be to attend a hospital for treatment, unhampered by the demanding toddler. The children gather in a hall or other suitable premises usually with adjacent open play space. The play-centres are open from 10 a.m. to 12 noon, and often from 1.30 to 3.30 p.m. for a different group of children, each school day. A paid superintendent, a lady with experience in group care of toddlers, assisted by paid assistants and voluntary helpers, is in charge of the group which numbers from 25 to 40. There is a short break about midway through each session when milk and a piece of apple are given and a short rest taken, the period prior to the break being devoted to free play, the period after to more organised activities, all carried out as much as possible in the open air. A weekly contribution is made by each mother and the local health authority makes an annual contribution towards each play-centre. The children attending are under regular medical supervision by medical officers of the local health department and annual dental inspections carried out by the school health service dentists.

NURSERY PLAY-CENTRES, TODDLERS' CLUBS, PART-TIME CRÈCHES. Voluntary bodies are particularly active in the field of part-time care of young children as well as organised groups of parents, although local health authorities may provide play-centres or part-time crèches at child welfare centres at times other than the regular clinic sessions. Some play-centres are held at community centres in connection with new housing estates, in the social or recreation room of a block of high flats, or even for very small groups, in the homes of the mothers concerned in the organisation of the centres. The objects of the play-centres, clubs, crèches or whatever other name may be given them, is to give mothers of young children 'an afternoon off' for shopping, visiting, hospital attendance, or just 'a rest'. The centres are usually open on one or two afternoons a week for about two or three hours. The persons in charge are again those with experience in the group-care of children, assisted by a visiting nursery school teacher or health visitor.

Many of these forms of group-care for young children require to be registered under the Nurseries and Child-Minders Regulation Act, 1948, but exemption is granted to play-centres, etc., which are maintained or assisted by local authorities. An interesting new development is the opening of play-groups in children's hospitals and units, the first being started at the Brook Hospital, Woolwich, in 1963 under the aegis of the Save the Children Fund (Harvey, 1965).

Nursery Nurse Training

The examining body in England and Wales for the nursery nurses' certificate is the National Nursery Examination Board. In Scotland the corresponding body is the Scottish Nursery Nurses' Examination Board, which grants a separate certificate. In both countries the training course lasts two years and includes infant and pre-school child care, experience in the care of the latter being obtained at nurseries, both day and residential, and nursery schools. The National Nursery Examination Board's examination is a written one, together with an assessment throughout training of the candidate's practical work and her record of observation which each must produce; the Scottish Board's examination is both written and practical.

Residential Nurseries

A few local health authorities, all in Scotland, maintain residential nursery accommodation for infants and young children, and in 1963 there were 16 such nurseries provided for short-term care in instances where the mother was ill or being confined. These nurseries are small and run on family-group lines and a charge is made for the service. The medical care of the children is undertaken by the medical officers of the local health authority. The children are examined

FIGS. 70 and 71. Infants and pre-school children in a purpose-built day nursery.

prior to admission and before discharge, and regular and frequent visits to the nurseries are paid by the medical officers. In England and Wales residential nurseries are under the control of the children's department of the local authority.

Mother and Baby Homes

Local health authorities and voluntary organisations, receiving financial support from local authorities, provide homes to which mainly unmarried mothers are admitted during the later stages of pregnancy. They remain with their infants for several weeks or even months after confinement which may take place in the home or in hospital. The primary object of these homes is to re-establish each mother in her own life with her baby if possible. Social workers employed by local health authorities or moral welfare associations are concerned with the case work. Mother and baby homes require to be registered with the local authority under the Public Health Act, 1936, or the Nursing Homes Registration (Scot.) Act, 1938, but a local authority may exempt such a home, either conditionally or unconditionally, an exemption which lasts for a maximum period of one year, but may be renewed.

Holiday Homes

Local health authorities usually give financial support to voluntary organisations providing these homes. The homes are very useful for affording an opportunity to mothers, accompanied by their infants or young children, to spend a fortnight's rest in the country or at the seaside. Young children after pneumonia or other respiratory infections benefit greatly from such holidays.

Domestic Help Service

This is a permissive service under the National Health Service Acts, and most local health authorities provide one. Infants and young children benefit from the service in that it allows them to remain at home during the illness or confinement of their mothers instead of having to be admitted to the residential nursery or the care of the children's officer. As part of their domestic help service, London County Council have a service of child helps who go into the homes of children temporarily deprived of their parents or guardians. Each child help acts as nearly as possible as a substitute mother, and the children remain at home. The staff engaged for this work requires to be carefully chosen. A charge is made for both the domestic help and the London child help service.

Accident Prevention Schemes

A Scottish Home and Health Department circular (3/1964) drew the attention of local authorities to the mounting figures of deaths occurring annually in Scotland from home accidents, pointing out that about 14 per cent of the deaths occurred in children under four years. The Department called for greater effort by local authorities in association with voluntary home safety committees to bring the public, especially mothers, into touch with home safety measures. The British Medical Association's report on Home Accidents (1964) called for a greater drive and co-ordination of effort, preferably through a single central government department, to publicise preventive measures, and advocated that a system of statutory notification of home accidents to the local authority should be seriously considered in view of the complete lack of accurate national statistics. The British Standards Institution has laid down many standards of safety for materials and equipment, including toys, used for and by young children, while it is actively engaged in considering standards for other equipment such as carry-cots. These standards are fully discussed by Glass (1964). Under the Consumer Protection Act, 1961, regulations are in force concerning the proper forms of guard required for various forms of heating appliance, while the Children's Nightdresses Regulations (1964) under the same Act prescribe that the materials used must conform to B.S. 3121. The dangers of fireworks were the subject of a joint conference between the British Firework Manufacturers' Safety Association and the Home Office (1963) and agreement was reached on several major matters. The problem of poisoning in childhood from drugs, domestic cleaning liquids and other toxic materials demands that these be stored in properly constructed cabinets and draft standards have been developed by the B.S.I. which specify the type of fastening device for such cabinets. A National Poisons Information Centre at Guy's Hospital, London, and a Scottish Centre at the University New Buildings, Edinburgh, were set up in 1963, and subsequent centres were opened at Cardiff and Belfast.

Home accidents in children constitute a great challenge and more must yet be done by local authorities in conjunction with local home safety committees to publicise home safety measures. The Royal Society for the Prevention of Accidents (RoSPA, founded 1916) through its *Safety News* (monthly) and *Home Safety Bulletin* (quarterly) and the assistance it gives in the organisation of local campaigns plays an ever-increasing and valuable role. Some local authorities either themselves or through voluntary home safety committees have schemes for issuing on loan fireguards and other safety devices to parents with young children. Apart from national campaigns, local activities include films, talks and demonstrations using models, posters, etc., and given at child welfare centres, women's guilds, young mothers' and parents' clubs, and conducting competitions, but above all, the personal advice to and education of parents in their own homes by family doctors and health visitors are the measures most likely to produce the best results.

Outside the home the greatest danger for children is the road (see Chapter 19). In an attempt to promote road safety measures for under five-year-olds, RoSPA in association with the government and local authorities launched the 'Tufty Club' scheme in December 1961. On payment of a small sum by the parents of young children, a booklet on road safety is issued and a badge for the child. By joining such a club, youngsters can be taught the simple rudiments of road sense and kerb drill either in groups or individually. Full details of the scheme are obtainable from RoSPA. Road safety training and education of schoolchildren are important but the slogan for the national road safety campaign for 1965 brings home the personal factor in all adults and children—'Road Safety Depends on YOU'.

Handicapped Children

A handicapped child has been defined as one who suffers from any continuing disability of body, intellect, or personality which is likely to interfere with his normal growth, development and capacity to learn. The early diagnosis of a handicapping condition is thus important so that such children and their parents may be afforded every opportunity of the fullest benefits of the specialist services and of the facilities offered by both voluntary and statutory agencies working in this field. Various simple screening tests have been evolved to diagnose early such conditions as deafness, cerebral palsy, phenylketonuria, and congenital dislocation of the hip. The conception of the child 'at risk' to handicap by virtue of hereditary factors, adverse antenatal, intranatal and post-natal conditions has been developed. The voluntary notification of congenital abnormalities introduced in England and Wales (1964) is a further step towards early diagnosis. Thus progressive local health authorities keep registers of children 'at risk' so that these children may be kept under expert observation by paediatricians or medical officers experienced in methods of developmental testing and diagnosis (Hughes, 1964). Similar registers of handicapped children are also kept to ensure proper supervision. Recognition of the importance of child development is evidenced by the foundation of a chair in that subject at London University (1964) and the projected national survey sponsored jointly by the Institute of Child Health of London University, National Birthday Trust Fund, National Bureau for Co-operation in Child Care, and the National Foundation for Educational Research, with financial backing from government, to further knowledge in educational, medical and social fields for the benefit of both normal and handicapped children.

The problem of the young chronic sick, 'perhaps the most unfortunate group in any community', was the subject of investigation in Scotland. The Report (1964) of a special sub-committee of the Scottish Health Services Council, while drawing attention to the lack of knowledge of the true extent of chronic sickness among the young, urged that measures should be taken to ensure early diagnosis; that no gap occurred in the supervision of children's health, especially in the transition between the child welfare and school health services; that a register of such children should be kept by the local health authority; that counselling centres for the guidance of parents, and day care centres should be set up; that a residential unit to serve Scotland was needed for those with multiple handicaps.

The most encouraging recent trend in the field of childhood handicap has been the increased provision for the care and training of the mentally deficient young child. Special advisory centres for these children and their parents, training or occupation centres run on day nursery lines, and short-term residential units are examples of developments in this direction. Much stimulus to these developments have originated with the National Society for Mentally Handicapped Children (1946).

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Chapter 13

THE SCHOOL HEALTH SERVICE

Administration

A STUDY of the framework of school health services in other countries shows much variation in historical development and in forms of administration. In the Netherlands the beginnings of a school health service are early discernible, two school medical officers having been appointed as early as 1868 by the municipality of Haarlemmermeer. The promulgation of the Compulsory Education Act in 1901 was a strong stimulus to municipalities to organise the medical supervision of schools, in most cases through the part-time employment of general practitioners. but it was not until 1942 that the first legal regulations were made covering the school health service. Responsibility for the service in the Netherlands remains in the hands of the municipalities, except in one province where a voluntary organisation is in charge of school health work. There are some 400 full-time medical officers who supervise all nursery and primary and an increasing number of secondary schools.

In the U.S.A. development appears to have been haphazard. In most areas, including large towns, the service is provided by boards of education; in rural areas and in some large cities the county or city health departments are responsible; and in at least one city, the health department is responsible for the school health work in the elementary schools and the board of education is responsible for it in the secondary schools. General practitioners or paediatricians may be employed on a part-time basis for routine inspection while in many areas parents are asked to have their children examined by their own doctor. In some areas the school health service is still in the earliest stages of growth, and this is the case in Chicago where a school medical officer was for the first time appointed in 1950.

In England in 1907, and in Scotland in 1908, responsibility for the establishment of a school medical service, as it was then designated, was placed upon the local education authorities. The introduction of the National Health Service did not affect its status and the school health service remains a responsibility of the local authority.

From the beginning, the importance of full co-operation with the public health service was emphasised and the association was more closely cemented when in 1919 the Chief Medical Officer of the Board of Education became also Chief Medical Officer of the newly constituted Ministry of Health. Locally, also, this co-operation has developed after the same pattern, and today the school health service is an integral part of the public health department.

STAFF. In England, local education authorities must appoint a principal school medical officer with the function of administering the service and, as already indicated, this official is the medical officer of health. In Scotland, under regulations made in 1946, the medical officers of health are chief administrative school medical officers, and the day-to-day running of the service is in the hands of a

Chief Executive School Medical Officer and a Chief Dental Officer; in the case of smaller authorities the medical officer of health may act both as chief administrative and chief executive school medical officer. Under these senior officials is a staff of assistant medical officers, dental officers, nurses, physiotherapists, speech therapists, chiropodists and others. In order that these officers may be most profitably employed they should, as far as possible, be relieved of clerical work, and clerical assistants are therefore employed, not only centrally, but also in treatment centres, specialists' and dental clinics, and also, in some areas, in the medical rooms of the schools during the medical officers' routine visits.

In London and a number of areas, general practitioners are engaged part-time at inspection sessions and in most places school health work is undertaken along with their other work by assistant medical officers of the maternity and child welfare service, or by those engaged in general public health duties. In only a minority of areas has the school health service its own whole-time medical staff. The most recently published figures show that in England and Wales there are 2,521 medical officers equal in whole-time service to 978, the proportion of doctors to pupils on the registers being 1 to 7,200. There are no regulations concerned with the professional qualifications possessed by a school medical officer. In practice, however, the possession of a Diploma in Public Health or in Child Health is of considerable advantage. In England, medical examination for the ascertainment of the educationally subnormal child may be conducted only by a medical officer holding one of the special qualifications defined by the Ministry.

The school nurse is a fundamental constituent of the school health service. She is present at the doctor's inspection and immunisation clinics; carries out the work of the treatment centres; is responsible for her own classroom and cleanliness inspection, her own examinations of vision and of hearing, and for health instruction; acts as liaison officer between doctor and teaching staff, and visits the homes of those requiring supervision or after-care. Her other activities vary according to local conditions. In an increasing number of areas she combines the duties of maternity and child welfare health visitor and school nurse and in some she also undertakes domiciliary nursing duties. The most recently published figures for England and Wales show that there are 7,610 school nurses, equal in whole-time service to 2,610. It is the official policy that, except in certain circumstances, all school nurses shall have the health visitor's certificate but in many areas it is increasingly difficult to attract holders of this extra qualification and nurses who have had only a general training are employed. Non-professional, specially selected women too, are engaged in cleanliness inspections, weighing and measuring and other tasks not requiring the skill of a trained nurse.

The primary function of the school health service at its inception was to detect at the earliest possible stage, physical defects which might prevent the child from benefiting from education. This limited objective has since then been so widely extended that every influence, and every agency, affecting the health and welfare of the school child may now be said to be the concern of the service. Its activities are described in the subsequent sections of this chapter.

Accommodation

School Medical Rooms. Suitable medical rooms are often lacking in older school buildings and the school doctor and nurse may be constrained to work in a classroom, a staff room, or other makeshift accommodation, but in every school of modern design there is, or should be, a medical room where privacy can be assured; of a size adequate for the testing of vision and hearing; and having in its immediate vicinity a waiting-room or waiting space for mothers and children.

School Clinics. A school clinic supplies, as a minimum, a consulting room in which the school medical officer may hold his diagnostic session and a minor ailments treatment room. Accommodation for dental treatment, consisting of a surgery and recovery room, is, as a general rule, incorporated and there may be provision for specialists' clinics. The sub-joined plan (Fig. 72), kindly prepared by the City Architect, Edinburgh, provides for these services. Extra rooms would be required for physiotherapy, speech therapy, and other specialised treatments.

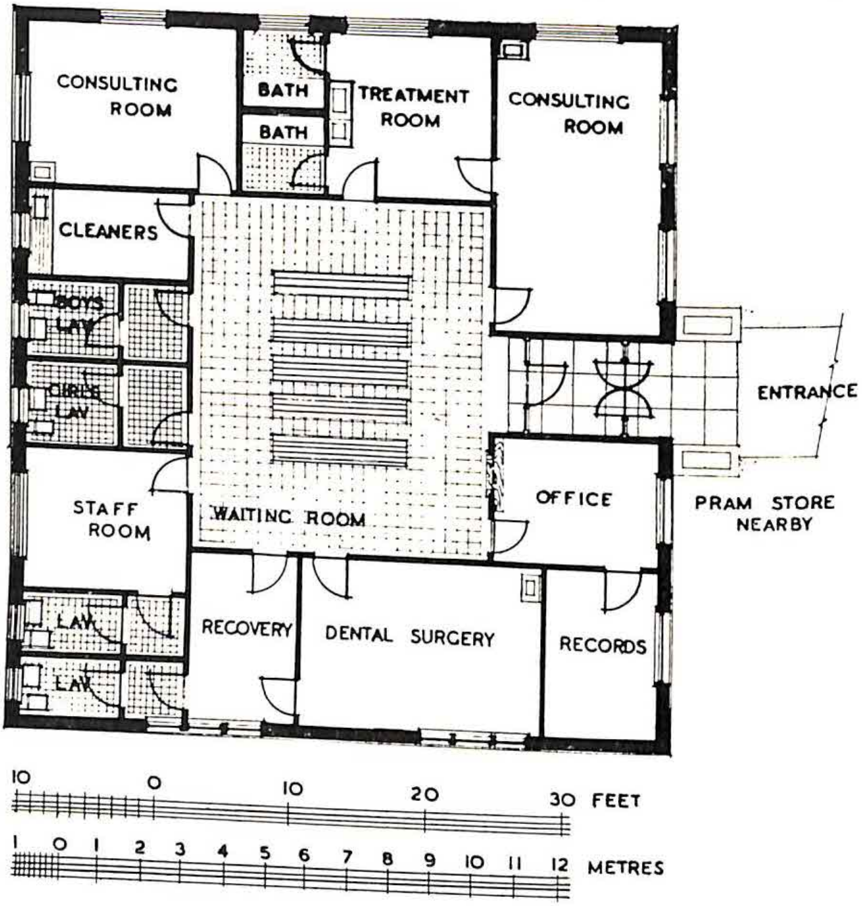

Fig. 72. Plan of a School Clinic.
(*Courtesy of the City Architect, Edinburgh*)

Inspection

Periodical medical inspection was the principal, and almost the only, employment of the medical officer when the service was first constituted. It continues to be his basic activity, and the most recent education acts have made this inspection compulsory. In England the Ministry's policy has been to provide a general medical inspection of each pupil on not less than three occasions at appropriate intervals during the period of compulsory school age, it being left to the local authority to decide when these inspections shall be held and whether additional general inspections shall be provided. Under most authorities children are examined at the ages of five, ten and fourteen, but in London the ages are five, seven, eleven and fourteen. In Scotland, according to regulations issued yearly, the ages have been five, nine, thirteen and sixteen. There is no doubt that, in the earlier years of the school health service, periodical inspection of whole groups of children according to age was the best procedure for ascertaining defects in the school population. Since then conditions, medical, social and educational, have greatly changed and the value of repeated inspection has been seriously questioned. The central departments today, therefore, not only allow but encourage local authorities to look for more efficient procedures. A number of authorities, while retaining the first and last inspections, have amended their programmes so as to omit the intermediate inspection and introduce a more continuous health supervision of the child by close contact between medical officer, school nurse, parent, teacher and family doctor, re-inforced by clinical examination when such examination is required.

The results of inspection are entered on the main School Medical Record Card, which provides space both for clinical observations and for information about the child's environment, as is shown by the headings given below:

ENGLISH CARD:

1. Name: Date of birth.
2. Local Education Authority.
3. Address.
4. School.
5. Family history.
6. Significant home conditions.
7. Illnesses; operations.
8. Prophylaxis (smallpox, diphtheria, etc.).
9. Family doctor.
10. Educational attainments; regularity of attendance.
11. Summary of findings:
    - Age.
    - Type of inspection.
    - Parent present.
    - Height.
    - Weight.
    - Cleanliness.
    - Infestation (head; body).
    - Teeth.
    - Skin.
    - Eyes—(*a*) Vision, (*b*) Squint, (*c*) Others.
    - Ears—(*a*) Hearing, (*b*) Otitis media, (*c*) Others.
    - Nose and throat.

Speech.
Lymphatic glands.
Heart.
Lungs.
Developmental—(*a*) Hernia, (*b*) Others.
Orthopaedic—(*a*) Posture, (*b*) Feet, (*c*) Others.
Nervous System—(*a*) Epilepsy, (*b*) Other.
Psychology—(*a*) Development, (*b*) Stability.
Abdomen.
Menstruation.
Physical condition: Satisfactory; unsatisfactory.
Initials of Medical Officer.

Medical Examination and Notes

12. Vision (acuity tests).
13. Colour vision.
14. Hearing.
15. Special tests.
16. Special educational treatment (state category, recommendation and date).
17. Clinical notes.
18. Employment (specify any type of employment considered unsuitable).

Some authorities make provision on the card for recording the breaking of the voice of boys as well as the onset of menstruation in girls and this enables comparison to be made between height, weight and stage of maturity of both sexes.

The figures published in 1964 show that a total of 2,010,215 children were inspected; the physical condition of 99·5 per cent was satisfactory and that of 0·5 per cent unsatisfactory.

The Scottish card differs considerably from the English card both in its sections and in its headings.

Medical inspection is, as a general rule, carried out in the medical room in school, but where such accommodation is not available the inspection is carried out at the nearest school clinic or treatment centre. The school nurse is in attendance, and in some places it is the practice for the teacher also to be present. Arrangements in London are unique in that the following up of children found at medical inspection to be in need of treatment is the responsibility of voluntary care committees, whose members number some 2,500 workers and whose representatives attend inspection sessions. In other places supervision and follow-up are the responsibility of the school nurse.

Parents must be notified of the time of inspection and this is often done by sending a letter of explanation which, in addition to inviting the parent to attend, contains a list of questions about the child's health history which the parent is asked to complete and return. Although the presence of parents tends to slow down the session it is a great advantage if they can be present to supplement the medical history, receive advice from the medical officer and have explained to them the need for any treatment that may be recommended. Each child on his first inspection has his card made out by the teacher who enters such particulars as come within her province. Information of a confidential nature, such as the family history, should be obtained and recorded not by the teacher but by the doctor or school nurse.

Height and weight should be measured by the nurse, and not by the teacher, and children should be weighed wearing vest and pants without footwear. It is essential that the balance should be regularly checked and kept in good order. The children are presented to the doctor for examination one by one. Those found to be in need of treatment or further investigation are referred to the appropriate agency, or put down for special examination later either in school or at the doctor's diagnostic session at an appropriate clinic, and every child requiring special care in school is notified to the teacher. Special examinations are conducted at any age in the child's school life either on account of some condition found or suspected at routine inspection or at the request of parents, school nurses or teachers.

Records. Liaison with the child welfare medical officer should be such that the records of his department are made available to the school health service when a child reaches school age. Entries on record cards should be accurate, legible and adequate, and reports from specialists, hospitals, etc., should be attached. In some fortunate areas, co-operation with the hospitals is so good that a report is sent to the school medical officer on every schoolchild discharged after treatment. The record card provides for the school doctor and school nurse information which they require throughout the child's school life, and it furnishes the statistical information incorporated in the school medical officer's annual report to the Ministry or Department of Health. There is no standard procedure for the filing of record cards. In some areas they are kept in the central office and are taken out to the schools by the school medical officer on each occasion on which a visit is paid; in others, information about exceptional pupils is available at the central office but the record cards are kept in the individual schools. Under the latter arrangement, special care must be taken to prevent access to them by unauthorised persons. The card follows the child as he moves from school to school and, it may be, from place to place, securing a continuity of record not affected by any change of family doctor, and when completed at the end of the child's school career is a source of information which is often not be be found elsewhere, and which can be made available to the general practitioner, the factory surgeon, or other medical persons with the permission of the individual concerned. Inquiries about a pupil's medical history while at school may be made years after school-leaving age has been passed and records should, therefore, remain in the custody of the school health service and should not, as is the procedure in some places, be transferred through the local executive council to the general practitioners.

Treatment

In the Netherlands, Denmark, and other countries of the Continent, prevention and cure are entirely separated in school health work. No treatment whatever is provided and every child who requires it is referred to the family doctor. Conditions are different in Great Britain where the National Health Service Act has not relieved the local education authority of the duty laid upon it by the Education Acts of 1944 and 1962 to make arrangements for securing the provision of free medical treatment for pupils attending all schools which it maintains.

SCHOOL TREATMENT CENTRES. School health services, therefore, continue to provide clinics for eye refractions, ultra-violet light therapy, physiotherapy, orthoptics, chiropody and for the care of minor ailments, such as impetigo, scabies and ringworm of the body, which experience has proved can be treated in this way more satisfactorily and with less loss of school-time than by general practitioners. Speech therapy and child guidance (see Chapter 15) are organised as part of the school health service in England and as part of the educational service in Scotland.

SPECIALIST CLINICS. Under the National Health Service Act the provision of specialist clinics became, in the main, the responsibility of regional hospital boards. Over previous years the school health service had built up its own organisation of specialist clinics for certain disabilities in its treatment centres, in schools, or in other premises, and, where practicable, these clinics have been continued under the charge of specialists provided by the regional boards. Where these arrangements have not been continued, special clinics for school children may be held in the hospitals. If it appears desirable to do so, local authorities still have power to provide and pay for any specialist service for school children.

Specialists engaged in school clinic work are the paediatrician, the orthopaedic surgeon, the cardiologist and the dermatologist, but the specialist clinics most frequently provided are those of the ophthalmologist and the aurist. Indeed, the great majority of children with visual defects and squints and very many with hearing defects and unhealthy tonsils and adenoids obtain treatment through the school health service.

'CLEANLINESS' CLINICS. This euphemism is officially applied to de-lousing centres. In the 1908 report of the Chief Medical Officer of the Board of Education, the first to be made, it is recorded that 50 per cent of the girls examined in town areas were verminous. During the subsequent thirty-two years it was confidently believed that cleanliness was being steadily achieved and figures published in school medical officers' annual reports supported this confidence. But the mass dispersion of town children during the early war years into country areas brought to light a state of affairs which at times was rightly described as appalling and in 1940 Kenneth Mellanby, in his paper 'The Incidence of Head Lice in England' produced figures showing an infestation rate of 30 per cent in schoolboys and 50 per cent in school-girls—figures three times as high as those published in school medical officers' reports. Since the war the incidence has fallen steadily and 'bad heads' such as used to be far from uncommon are now but rarely seen. The rate varies considerably from district to district, there being some happy areas where all children are vermin-free, but the incidence in England and Wales as a whole was 1·7 per cent in 1964.

The Education Acts of 1944 and 1962 take full cognisance of the problem of infestation and provide powers for compulsory inspection, for compulsory treatment at cleanliness clinics, and for the prosecution of parents through whose negligence re-infestation occurs. Useful though these powers may be in individual cases, they will not eliminate lousiness, for the schoolchild most frequently acquires his vermin from reservoirs of infestation beyond the reach of these powers, from pre-school brothers and sisters, from older sisters and from the mothers themselves. Lousiness is a family affair, a form of dirtiness indicating great ignorance and a defect in the social conscience, not a lack of medical care, and schoolchildren will remain verminous until, through patient education and the pressure of public opinion, lousiness comes to be universally considered as a piece of intolerable bad manners.

THE SCHOOL HEALTH SERVICE AND THE FAMILY DOCTOR. Except when treatment can be most suitably and conveniently provided in the clinics and centres previously described, the curative care of diseases diagnosed by the school medical officer is the responsibility of the family doctor, to whom such cases are therefore referred. Close co-operation with the general practitioner is of fundamental importance to the success of school health work. In actual practice, the degree of co-operation varies greatly and in order to foster it a recommendation has been made by responsible medical bodies that a child, found by a school medical officer to need special investigation or treatment, shall be sent to a consultant only after prior consultation with the child's own doctor, to whom a copy of all reports from the consultant shall be sent. The welfare of the schoolchild is best served where this recommendation is implemented and where, in addition, personal consultation on problems affecting individual children takes place frequently and freely between the school medical officer and the general practitioner.

Pupils Requiring Special Educational Treatment (Handicapped Pupils)

Under the Education Act, 1944, and the Education (Scotland) Act, 1962, it is the duty of an education authority to ascertain what children in its area require special educational treatment. In forming a judgment the education authority is called on to consider not only the school medical officer's advice, but also any reports or information which can be obtained from teachers or other persons with respect to the ability and aptitude of the child. Among the 'other persons', the educational psychologist is most frequently the source of information. It is also the duty of the education authority, having ascertained what children in its area require special educational treatment, to make appropriate provision for them, and the general categories of handicapped children have been laid down by the Minister of Education and the Secretary of State. It must be remembered that the canon applied to the handicapped pupil is primarily neither a medical nor a social, but an educational one.

The regulations pick out for special mention two categories, the blind and the deaf, who must be educated in special schools for the blind or the deaf, even if one or more of the other handicaps is also present; other handicapped children are to be educated in ordinary schools, special schools, hospital classes or at home, as the case may be. Whenever it is possible, a child should remain in an ordinary school, where, among other advantages, he may enjoy those activities of school life which are additional to, and as important as, the formal work of the classroom. To do so, the child with a disability may need such special treatment as the provision of a hearing aid, exemption from strenuous games, or some particular seat in the classroom. But if his handicap is educationally too great to be overcome in an ordinary class, special classroom instruction must be provided. In the U.S.A. provision for the handicapped child is made largely by means of special classes in ordinary schools but in this country, though many such classes do exist, provision to a large extent is made in special day or residential schools. If, after a period of special educational treatment a pupil is found to be fit for ordinary education he ceases to be a 'handicapped pupil' and returns to the normal stream of education.

In some municipal areas the provision of special educational treatment may be considered as adequate, and transport difficulties are overcome by delivering children to and from their homes by ambulance or special omnibus, but in many country districts it is lamentably inadequate or, indeed, unobtainable and over the country as a whole there is a shortage of day and residential schools.

EARLY ASCERTAINMENT. Early ascertainment of handicap is of great importance to the child and also to the parents, and as soon as a child has entered upon school life, the medical officer should be vigilant to suspect and detect handicap. But ascertainment before school age is reached is desirable in every kind of handicap and, in certain categories, notably the deaf, it is absolutely necessary if the child is to benefit fully from special educational treatment. For this reason an education authority has powers to secure the examination by the school medical officer of any child who has attained the age of two years. (In Scotland this examination can be carried out only at the parent's request.) Such early ascertainment may secure for the child preventive or curative treatment which has not yet been furnished through the channels of the National Health Service. It may make available to the parents specialist advice on the training and management of the pre-school handicapped child, and it may make possible admission to a special nursery school, for there is some, limited, nursery school provision for the blind, deaf, educationally subnormal, and for children with physical handicap. Even if special nursery school provision is not available, admission to an ordinary nursery school may be possible and of benefit to the handicapped child. The upper limit of compusory school age is, for the handicapped child, not fifteen but sixteen years.

In the child welfare departments of many local authorities registers have now been set up of infants showing congenital defects; others have 'at risk' registers containing the names of infants who because of family history or prenatal, intranatal or postnatal circumstances appear especially likely to be handicapped. When there is good co-operation between the child welfare and school health services these registers are a valuable aid to the school medical officer in his task of early ascertainment.

The categories of handicapped children according to the Ministry of Education are:

	Registered Pupils
(*a*) *Blind Pupils*, that is to say, pupils who have no sight or whose sight is or is likely to become so defective that they require education by methods not involving the use of sight . .	0·2 to 0·3 per 1,000
(*b*) *Partially Sighted Pupils*, that is to say, pupils who by reason of defective vision cannot follow the normal régime of ordinary schools without detriment to their sight or to their educational development, but can be educated by special methods involving the use of sight	1·0 per 1,000
(*c*) *Deaf Pupils*, that is to say, pupils with impaired hearing who require education by methods suitable for pupils with little or no naturally acquired speech or language . . .	0·7 to 1·0 per 1,000
(*d*) *Partially Hearing Pupils*, that is to say, pupils with impaired hearing whose development of speech and language, even if retarded, is following a normal pattern, and who require for their education special arrangements or facilities though not necessarily all the educational methods used for deaf pupils .	1·0 upwards per 1,000

(*e*) *Educationally Subnormal Pupils*, that is to say, pupils who, by reason of limited ability or other conditions resulting in educational retardation require some specialised form of education wholly or partly in substitution for the education normally given in ordinary schools	10 per cent (1·5 per cent requiring transfer to a special school)
(*f*) *Epileptic Pupils*, that is to say, pupils who by reason of epilepsy cannot be educated under the normal régime of ordinary schools without detriment to themselves or other pupils	0·2 per 1,000
(*g*) *Maladjusted Pupils*, that is to say, pupils who show evidence of emotional instability or psychological disturbance and require special educational treatment in order to effect their personal, social or educational readjustment . . .	About 1 per cent
(*h*) *Physically Handicapped Pupils*, that is to say, pupils not suffering solely from a defect of sight or hearing who by reason of disease or crippling defect cannot, without detriment to their health or educational development, be satisfactorily educated under the normal régime of ordinary schools	5 to 8 per 1,000
(*i*) *Pupils suffering from Speech Defect*, that is to say, pupils who on account of defect or lack of speech not due to deafness require special educational treatment	1·5 to 3 per cent
(*j*) *Delicate Pupils*, that is to say, pupils not falling under any other category in this Regulation, who by reason of impaired physical condition need a change of environment or cannot, without risk to their health or educational development, be educated under the normal régime of ordinary schools .	1 to 2 per cent

In Scotland, the term 'Mentally handicapped' pupils is used, not 'Educationally subnormal', and there is no category of delicate pupils.

Blind pupils. Although these children are educationally blind, many have some, and it may be a useful, degree of vision. A visual acuity of 6/60 with correction or less in the better eye is the usually accepted standard. Available statistics show that blindness in children has declined during the present century and this fall in numbers can in the main be attributed to the reduction in the incidence of ophthalmia neonatorum.

Facilities exist for the education of blind children from the age of two years. There is some day-school provision, but the greater number of blind pupils attend residential schools where they remain until the age of sixteen. The majority then proceed to training for employment as blind persons, while those of good intelligence with an aptitude for study may enter one of the two residential senior secondary schools where they remain until the age of nineteen. In Scotland almost all blind children remain at school until they are eighteen.

The blind child receives a general education by special methods involving sound and touch, and he learns to read with his finger tips, the letters being represented not by a raised letter type but by patterns of raised dots known as Braille type, a system invented by a Frenchman of that name who was a teacher of the blind in Paris in the first half of the nineteenth century. In England and Wales there are 18 schools for the blind only and two which accept both blind and partially sighted. In Scotland there are 13 schools for the blind and the partially sighted.

Partially sighted pupils. The first special class for high myopes and children with severe visual defects was opened in London in 1908 and provision of special educational facilities was gradually extended throughout the country.

Among these children there have always been some whose vision is defective from congenital causes such as albinism or cataract, or acquired causes such as corneal scarring, but myopes formed the great majority of pupils and the schools were known as 'sight-saving'; 'sight-conservation' (a term still in use in the U.S.A.) or 'myopia' schools, in the belief that the use of the highly myopic eye in the work of an ordinary school caused deterioration of vision or added to the risk of complication. Most ophthalmologists, however, now hold that only a small proportion of myopic eyes are susceptible to this danger and it is customary to consider partially sighted children as consisting of two groups, those, relatively few in number, whose vision may progressively deteriorate if they remain in an ordinary school and the larger group who require special education simply because they cannot see well enough to keep up with their classmates. The Board of Education's Committee therefore put forward the following general principles:

1. If the eyes show fundus changes indicative of a serious condition of myopia the child should always be admitted to a special school.

2. In the absence of such fundus changes the child should usually be admitted to a special school if:

(*a*) after repeated examinations it is found that the myopia has been increasing steadily at the rate of more than one dioptre per annum;

(*b*) after a period of slow rate of increase or apparent arrest it is found that there is a sudden rise in the rate of progress to more than one dioptre per annum.

3. The actual amount of myopia should not be the sole factor in determining whether a child should be sent to a special school.

4. The age of the child must be taken into account. The younger the child the more serious are factors such as degree of myopia present and the rate of progress of that myopia. In doubtful cases the existence of a history of myopia in the family may be a deciding factor.

5. Myopic children with a visual acuity after correction of 6/24 or worse should be admitted to a special school, though the majority of these will probably fall within category 1 above.

As a consequence of this change in outlook, many myopic children are now left, without detriment, in ordinary schools who previously would have been transferred, and the number of pupils requiring admission to the special schools, now renamed schools for the partially sighted, has fallen. In Edinburgh the school roll numbered 79 in 1930, and 30 in 1964.

Since the war, day-class and day-school provision has expanded, the practice of educating the partially sighted with the blind has been corrected and special boarding schools for the partially sighted have been built in several parts of the country. In these schools, special attention is paid to lighting and wall surfaces. In the teaching of writing, use is made of individual blackboards and of large-sized exercise books. The early readers used for normally sighted children are printed in a size of type suitable for most partially sighted children, but difficulties arise later when size of print for normal children decreases and, in the absence of suitable books in the commercial market, teachers at one time had to give much labour to producing their own sheets of reading matter. The introduction in recent years of the 'Leeds' and the 'London' magnifying lens, which make possible the reading of books of ordinary print, has largely overcome this problem and a limited number of partially sighted children have obtained much benefit from the use of Keeler magnifying spectacles. In England and Wales there are 36 schools for the partially sighted only and two which accept both partially sighted and blind pupils; in Scotland there are 13 schools for the partially sighted and the blind.

Children with defects of hearing. *Methods of ascertainment*. Children have a surprising and at times disconcerting ability to conceal defects of hearing and this is often because they have unknowingly acquired skill in lip-reading. The clinical methods most commonly employed in ascertainment are the watch, the 'forced whisper', and the conversational voice tests, of which the last is most satisfactory. But all are liable to error, often failing to pick up milder degrees of general deafness and severe degrees of high-frequency deafness. Audiometric testing, therefore, is now widely used in schools, the amount of deafness in any particular child being recorded numerically in decibels. In different areas the testing is carried out by school nurses, by teachers of the deaf, or by others specially trained in the technique. The gramophone audiometer, now obsolete, has been replaced by the pure tone audiometer which gives reliable results with children as young as five years of age. A rapid 'sweep test' of individual children is applied to all school entrants and to other age groups as a screening procedure and is followed by detailed testing of those who appear to have a defect. Although audiometric testing is in many ways more accurate, it too, is liable to error and should be looked at as supplementary to, not a substitute for, clinical investigation.

The Board of Education's Committee of Inquiry recommended that children with hearing defects should be classified as follows:

Grade I. The children in this grade can hear and understand conversation at 20 feet and over in ordinary classroom conditions. They have a hearing loss up to about 15 decibels (G.A.) or 35 decibels (P.T.A.). They can be educated in an ordinary school without any special adjustments being made. This group also includes some children with greater hearing loss whose speech and language development is good and who lip-read well. The hearing of many of the children in this grade would benefit from medical treatment, but they do not require the use of hearing aids in school.

Grade II (*A and B*). The children in this grade can hear and understand conversation between 20 feet and 2 feet away in ordinary classroom conditions. They have a hearing loss between 15 and 40 decibels (G.A.) or 35 and 60 decibels (P.T.A.). By reason of their defect they cannot be properly educated without special arrangements or educational facilities. At the same time their hearing defect is not sufficiently severe for them to need education by the methods used for deaf children without naturally acquired speech or language. Into this grade come those children whose hearing defect is worse than that described above but whose speech and language development are not seriously defective. The hearing of a certain proportion of the children in this grade would benefit from medical treatment, and most of them can be helped by the use of hearing aids.

Grade III. The children in this grade can hear and understand conversation at not more than 2 feet, if at all, though they may be able to hear vowels, with or without distinguishing between them at distances greater than 2 feet. Their hearing loss is over 40 decibels (G.A.) or 60 decibels (P.T.A.) and may be total, Their speech and language, if any, are seriously defective, and, because of their loss of hearing, cannot be developed except by the methods of teaching applicable to deaf children who have not acquired speech and language naturally. This grade does not include any children, no matter what their hearing loss, whose speech and language development are not seriously defective. The hearing of few children of this grade can be improved by medical treatment, but many can be helped by the use of hearing aids.

Deaf pupils (*Grade III*). Though educationally deaf these children often have some hearing which may be useful, of which advantage is increasingly being taken by means of hearing aids. Approximately two-thirds are congenitally, and one-third adventitiously, deaf.

The most important years in the deaf child's education are those before the age when compulsory education begins. The defect of hearing, must, therefore, be discovered at the earliest possible age and the number of diagnostic and advisory units throughout the country is rapidly increasing. At these 'audiology units', which may be sited in hospitals, in clinics of a local authority or in schools for the deaf, diagnosis is established and auditory training for the child and guidance for the parents are provided. Nursery school accommodation, too, is available and is of the greatest value to the deaf child. The history of the evolution of the teaching of the deaf is the history of a struggle, protracted, stubborn, and often bitter, between those who advocate manual methods and the protagonists of oral teaching. The manual method makes use of finger spelling and a conventional vocabulary of hand movements or signs whereas in oral teaching, meaning is conveyed by speech and obtained by lip-reading. Oral teaching is practised in all schools in this country, but a proportion of the children fail to make progress with speech and lip-reading. The majority, however, can understand and to some extent employ oral speech; a knowledge of the manual method is acquired by all in their leisure time; and all children, therefore, leave school able to communicate with other deaf persons, with the officers of the voluntary associations responsible for their after-care, and, to a widely varying extent, with members of the general public. A general education is provided to the age of sixteen in special day-classes and day-schools and also in special residential schools, and in the older classes vocational instruction is given. Senior secondary education is available for the relatively small number capable of profiting from it. In England and Wales there are 14 schools for the deaf. In Scotland 13 special schools or classes accept deaf children.

The child who has already acquired speech and language in the normal way before the onset of deafness does not present the same educational problem as the deaf child without speech. The former needs special educational treatment which will maintain and develop the natural speech already possessed and this can often best be done in a school or class for the partially hearing.

Partially hearing pupils. (*Grade II*). These children have at least the rudiments of naturally acquired speech and language and are accustomed to the use of words. The education provided for them, is, therefore, quite different from that devised for the deaf child. There are cases of severe partial deafness for whom immediate transfer to a special school is justified, but almost all should pass a probationary period in an ordinary school during which not only the degree of hearing loss, but the quality of speech and knowledge of language, the ability to lip-read, and the educational progress can be studied. A favourable position in the schoolroom should be provided for all. Emotional disturbance, resulting from feelings of frustration and inadequacy, is not uncommon in Grade II children and is a strong argument in favour of transfer to a special school.

Instruction in lip-reading should be made available to Grade II children during this probationary period either by gathering them together at a convenient centre or by the appointment of an itinerant teacher who should be either a teacher of the deaf or a speech therapist skilled in lip-reading. In the last few years hearing aids in increasing numbers have been issued to Grade II children, but by no means all are willing to wear them or able to profit from them. With suitable placing in class, instruction in lip-reading, and the provision of hearing aids, the majority of Grade II children can be suitably educated in ordinary schools (Grade II*a*). The others should be transferred to special classes or schools (Grade II*b*).

In England and Wales there are 7, and in Scotland 4, schools for the partially hearing and in a number of areas special classes are held in ordinary schools. Particular attention is given in those classes and schools to speech and language and to lip-reading, and use is made of group hearing aids, or of individual aids in conjunction with the loop system of communication. Many of the pupils are, or should be, able later to return to ordinary schools as Grade II*a* pupils. For those remaining, provision is made in the higher classes for practical activities related to vocational needs.

Delicate children. For a full discussion of the historical development and the present provision of education for the delicate child, the reader is referred to 'The Health of the School Child', 1952. The first open-air school was opened in England in 1907 for 'anaemic and unhealthy children' and in subsequent years other open-air day-schools and later residential schools have been established in different parts of the country. These schools are intended to provide fresh air, rest, suitable diet, a hygienic way of life, medical care and individual attention as well as modified education. As a rule the length of stay is six months to two years. Respiratory diseases and debility resulting either from disease or because of unsatisfactory home conditions were, and are, the commonest causes of transfer to these schools. During the last fifty years standards of school buildings have changed and many ordinary schools are now more 'open-air' than some of the open-air special schools. The cult of 'fresh-air', too, has been modified. There is no longer a fanatical belief in the virtue of being out of doors in all weathers and the rigours of the original open-air school régime are now being modified. The glazing and heating of class-rooms and rest-rooms is now in progress with approval, and indeed with active stimulus from the Ministry of Health.

The conclusion pronounced by the Chief Medical Officer to the Ministry of Education in 1951, was that there was still a place for special schools for delicate children, especially for those living in industrial areas; that there was no justification for much expansion; and that it might be that the need for these schools would diminish with the years.

Epileptic pupils. Children with petit mal and those with major epilepsy whose fits are only nocturnal or occur infrequently during the day can and should be retained in ordinary schools and every effort must be made to persuade headmasters and class teachers to accept the presence of such a child and to make suitable provision for care during a seizure. On the other hand, a child who frequently has major fits, or fits of long duration is almost impossible to manage in an ordinary class. The child whose epilepsy takes the form of psychomotor attacks involving antisocial or even dangerous acts is also unfit for ordinary schooling and so is the epileptic with personality disorders the result of his own reaction, or more often the reaction of other people, to the affliction. It has been estimated that over 1·0 per 1,000 school children are epileptic but less than one in five of these needs special educational treatment and the number diminishes as therapeutic control of the disorder becomes rapidly more effective.

Some epileptic children can be suitably placed in day-schools for the physically handicapped where the tempo of school life is slower and more flexible and the teachers and attendants are accustomed to the management of the ailing. Some who are at the same time educationally subnormal may most appropriately be taught in schools for children of that category. For a few, the handicap may be so great that they remain at home and such tuition as they are capable of receiving is given by a visiting teacher. Provision for the remainder of those requiring special educational treatment is best made in residential schools for epileptics of which there are six in England and one in Scotland.

The purpose of these schools is to provide a general education designed to suit a very considerable range of ability; to control the seizures by appropriate treatment; and to re-establish the emotional life of the child if this has been disturbed. After a period of residence some of the children are able to return home and resume day-school education. For those who remain, vocational instruction is given in the later years of schooling, in gardening, wood, leather and metal-work and domestic science; and this enables some at the end of their school life to face employment outside. Those who still need care may be admitted to colonies for adult epileptics.

Educationally subnormal pupils (*Mentally Handicapped*). The Scottish Advisory Council's report in considering the education of pupils with mental or educational disabilities, allocates them to the following categories:

(*a*) pupils requiring special education because of absence, frequent change of school, faulty teaching and other similar causes;

(*b*) pupils with specific disabilities in reading, arithmetic, spelling and other school subjects;

(*c*) pupils who are retarded, but who are capable of making some progress in the school arts, usually with intelligence quotients ranging from approximately 55 to 70;

(*d*) pupils who are unable to make much progress, if any, in the school arts, but who are capable of being trained, usually with intelligence quotients from approximately 40 to 55;

(*e*) pupils who have defects of personality to such a degree that they cannot profit from educational services or who have a harmful influence on others.

Groups (*a*) and (*b*) remain in ordinary schools where their educational difficulties should be met, if circumstances permit, by individual attention from the class teacher or head teacher, or by the provision of adjustment classes such as are now being organised in many areas to serve the needs of individual schools or groups of schools. The teachers of these classes are advised and visited by the educational psychologist; the classes are small with a roll of nine pupils or less, allowing individual tuition; and pupils remain in the adjustment class for instruction in the subjects in which they require assistance, returning to their regular classes for other studies and activities. Individual tuition and special educational treatment may also be provided for these children at the child guidance centre of the local authority's child guidance service.

Groups (*c*), (*d*) and (*e*) are very much the concern of the school medical officer and their ascertainment must now be considered. Educationally subnormal children are brought to notice either at routine medical inspection or by the school nurse in the course of her inspections, or by the teacher because of failure to make progress in school. Not infrequently these children react to their handicap by behaviour-disturbance or truanting and may be referred by the parents, teachers, or the school attendance department for those reasons also. This may take place only after several years have been spent by the child in an ordinary school and in order that ascertainment may be early effected it is now the practice in most areas to subject all pupils to a group intelligence test, made by the class teacher with a non-verbal (picture) scale, usually at the age of seven when promotion takes place from the infant department of the primary school. All pupils who appear to be mentally retarded for one or other of the reasons mentioned are further investigated by means of an individual test or tests, the Terman Merrill revision of the Stanford Binet Scale being that most often used.

This individual examination is made by the school medical officer, or by an educational psychologist in those areas where psychological advice is available. Before definite ascertainment is made, the child must in all cases be seen by the school medical officer and a final decision is based on the doctor's examination, the teacher's estimate, records of school achievement, information concerning social environment, and the results of intelligence tests.

Transfer to a school for the educationally subnormal is best made between the ages of seven and ten. Before seven years the child can generally be coped with in the infant department of an ordinary school. After ten years there may be difficulty in adjusting the child to the methods of the special school. Past experience has shown that pupils with intelligence quotients between 55 and 70 are suitable for transfer to a school for the educationally subnormal, but in some cases these figures are extended to 50 and 75. It must ever be borne in mind that the numerical result of an intelligence test is only one of several factors which must be considered and that ascertainment on the strength of an I.Q. alone is never justified.

In areas of large population, educationally subnormal pupils are best taught in day-schools of their own. In smaller areas an all-age special class attached to an ordinary school is a better arrangement than that of leaving the mentally retarded in ordinary classes, but it is not an ideal form of organisation and as a general rule it is better that mentally retarded pupils in smaller urban and rural areas should be sent to residential schools, each serving the need of a number of authorities. Such residential schools, too, provide the best education for any educationally subnormal child who is disturbed in his behaviour, or whose home is broken or grossly unsatisfactory.

Pupils in these schools acquire the elements of numbers, reading, writing, and speech, by methods fitted to their need and their capacity, from teachers who have an appropriate extra teaching qualification. In their latter school years they should receive vocational training in domestic science, woodwork, gardening, and simple crafts as a preparation for employment when they leave school.

The situation of a child incapable of instruction even in a school for educationally subnormal pupils is not the same in Scotland as in England and procedure in each country must be considered separately. Many children, unable to profit from attendance at a school for the educationally subnormal, are capable of training in personal habits, good behaviour towards others, simple handicrafts, domestic work, and similar activities. Such children, having intelligence quotients between 40 and 55 and often described as 'ineducable but trainable', profit from admission to an occupational centre. In Scotland such children remain the responsibility of the education authority on whom the 1962 Act lays the duty of providing occupational centres which are, in law, special schools. Attendance at these centres is, therefore, compulsory between the ages of five and sixteen. Children found to be unsuitable for enrolment in an occupational centre are reported to the local health authority which is then responsible for supervision and care under the most recent Mental Health Act.

In England, children are reported to the local health authority at a higher level of intelligence than in Scotland, namely when they are incapable of attending a school for educationally subnormal pupils. The provision of training in an occupational centre or of supervision and care is then the responsibility of the health authority.

When a child, leaving school, is considered by the education authority to need care and guidance because of mental handicap the authority must in Scotland send a statutory report to the health authority. This is no longer a statutory duty in England, where, instead, informal passage of information takes place between the two authorities.

In England and Wales there are 381 schools for the educationally subnormal and in Scotland 105 schools and 49 occupational centres.

Maladjusted pupils. The Ministry of Education's estimate of incidence of this handicap is about 1 per cent, but the Advisory Council on Education in Scotland give 3 to 5 per cent as the probable figure. Maladjustment displays, or betrays, itself in many forms in the schoolchild. It may be by such clinical symptoms as nail-biting; tics; pica; enuresis or encopresis; by failure to make progress in class or a sudden deterioration in school work; by truanting; by temper tantrums; or by dishonest, aggressive, or destructive actions, which may end in delinquency. Fuller consideration is given to the maladjusted child in the chapter on child guidance. It is sufficient here to mention briefly the various forms of special educational treatment which may be provided by an education authority and which is in general under the supervision of an educational psychologist.

When maladjustment is associated with retardation in one or more subjects of study, individual help by the class teacher or a period of study in an adjustment class may enable the child to resume his proper level of school work and so restore his self-confidence. The cause of the child's maladjustment may, wholly or in part, lie in the school situation. Explanation of the cause by the psychologist may enable the head teacher and class teacher to collaborate in removing emotional stress. If, however, the association between the maladjustment and the school is too intimate and too powerful, transfer to another school may be the correct treatment. In some cases children who cannot be adjusted while they remain at home may be boarded-out with foster parents and attend an ordinary school near the foster home. For those whose emotional disturbance or antisocial behaviour is of severe degree there are 50 day or boarding schools in England and five in Scotland where constant observation, full investigation and intensive treatment can be given. By reason of their training the school doctor and school nurse are qualified to play an important part in the prevention of maladjustment and in its treatment in the earlier stages and more use might be made of their services than is at present the practice in most areas.

Physically handicapped pupils. The majority of children with physical handicaps are afflicted before reaching school age from congenital defects or birth injury or from infections, particularly poliomyelitis and non-pulmonary tuberculosis, and special educational treatment must be provided for them from the start of their school career. A minority of cases continues to occur during later years, chiefly as a result of poliomyelitis, of rheumatism, and of accidents. Over the country as a whole the number of physically handicapped pupils is diminishing, but it should be noted that the education of some three hundred gravely handicapped 'thalidomide' children born between January 1960 and August 1962 will for a time lay an additional responsibility on local authorities all over the country.

In the larger urban areas those who are fit to live at home and are not too gravely crippled attend special day-schools. For the home-bound or bed-ridden, education is provided by visiting teachers who work under the direction of the head teacher of one of the schools for the physically handicapped. Co-operation by the parent is essential if full advantage is to be taken of the visiting teacher service. Those who require extra medical or surgical treatment or who, because of adverse home conditions, cannot receive the care they need as well as those for whom special day-school education is not available, go to residential schools where, in addition to teaching staff, nursing, medical and specialist staffs are also provided.

In tuberculosis, orthopaedic and other hospitals where children are likely to spend some time, and where the nature of their disability does not make teaching inadvisable, education is provided by hospital schools or classes. For children confined to bed, individual methods are used. Others, who are mobile, are collected into small groups or classes. Hospital schools are not maintained by the regional hospital boards but by the local education authorities of the areas in which the hospitals are situated.

In England and Wales there are 34 schools for physically handicapped children only; 131 which accept both physically handicapped and delicate pupils; and 95 hospital schools or classes. In Scotland schools for the physically handicapped number 33 and there are 53 hospital schools or classes.

Children with cerebral palsy. The incidence of this affliction is estimated at 1·5 per 1,000 of the school population. Many of these children whose disability is of lesser severity can be suitably educated in schools for the physically handicapped; for the educationally subnormal; or in ordinary schools; but others must be considered as a special group of physically handicapped pupils having needs of their own. Interest in these children has grown rapidly in recent years and it has been found that a number of them, by the use of specialised educational methods, physiotherapy, speech therapy, and occupational therapy, develop their faculties, mental and physical, in a manner not dreamt of some years ago. Special classes or special facilities for children with cerebral palsy are now provided in 59 of the day or residential schools for the physically handicapped in England and Scotland. There are, in addition, 25 day or residential special schools for children with cerebral palsy only.

Children with speech defects. The normal child has achieved mastery of speech by the age of five. If he has failed to do so the child enters school with a defect which may be a cause of considerable social maladjustment, and an embarrassment to his educational progress. Defects in articulation are of many kinds and may be associated with other handicaps. In a considerable number of children, the condition is a nervous disorder—stammering—and for some of them special educational treatment should be given, appropriate to the emotionally disturbed child. A still larger group includes the lispers, the clutterers, those whose speech is marred by one or several consonant substitutions, and those with nasal speech, open or closed. In a substantial number of these, investigation shows that mental handicap or a defect of hearing is the cause, and educational treatment appropriate to these handicaps should be provided. There are other cases in this large group which result from malformation of some part of the speech mechanism and surgical or dental treatment may be required.

Lesser defects of articulation are often amenable to the speech training which should be part of the class curriculum in every school, but for the child with a more serious defect, unless the cause is deafness or mental handicap, therapy should be provided by speech therapists of the local authority either in the school attended, or in a central clinic. It is estimated that one speech therapist is needed for every 8,000 to 10,000 on the school roll but few authorities as yet employ an adequate staff of therapists and many smaller areas have none. Speech therapists should be under the direction of the school medical officer through whom all cases requiring therapy should be referred to the speech treatment clinic.

Congenital aphasia is a rare and obscure condition which needs further research to determine the appropriate treatment. Some children with this defect are referred to the speech therapist, others are found to be best treated by methods appropriate to the deaf child. In England and Wales the equivalent of 385 whole time speech therapists are employed by local education authorities and 85 in Scotland. There are two residential schools for children with speech defects.

Prevention of Infectious Diseases

Exclusion. The hopeful confidence of past generations that closure of, and exclusion from, school would effectually control infectious and contagious disease is no longer entertained by medical officers of health. Schools or departments are, therefore, rarely closed because of infections. Individual children are excluded if found to be suffering from infectious or contagious maladies, but less and less importance is paid to the exclusion of contacts, and there is now no contact exclusion because of chicken-pox, German measles, mumps, and whooping-cough, and only limited exclusion for measles. The recommendations laid down by the Ministry of Health and Ministry of Education should be consulted for the procedure to be followed in the case of each of the common infectious diseases.

IMMUNISATION AGAINST DIPHTHERIA. The maintenance of resistance to diphtheria in school children, already immunised in infancy, is effected by the giving of a reinforcing dose of the appropriate prophylactic to the five-year-old entrant, and again four or five years later. Those who have not been previously inoculated receive a full immunising course at whatever age they are first met by the school medical officer. An injection of prophylactic is given only when the written consent of the parent has been obtained. The low incidence of diphtheria has brought about an apathy in the general population and there is increasing unwillingness to consent, which can only be overcome by patient, personal persuasion by school doctors, nurses, and also teachers.

Tuberculosis

CASE FINDING IN SCHOOL. The presence in school of a case of active tuberculosis may endanger the well-being of the pupils, and, when co-operation is good between regional hospitals and school health service, the school medical officer is informed of every such case. Risk of dissemination from a young child is rare, for in early school life a pulmonary infection most often appears as a benign, non-infectious primary complex. Older pupils may develop lesions more dangerous to themselves and to their classmates but the greatest risk arises from an open case of tuberculosis in an adult employed in school. Of those so employed it is the teachers who are in closest and longest contact with the children and for this reason it is highly desirable that all teachers should undergo yearly X-ray examination. Acceptance of yearly examination is not a condition of service for the teacher, but education authorities, as a result of negotiations with teacher organisations, offer exceptionally generous sick pay regulations to those who consent to yearly X-ray examination. The Ministry of Education and Scottish Education Department have laid down the procedure to be adopted before a teacher suffering from tuberculosis is allowed to resume his duties. Two successive medical certificates must be presented, the first stating that the disease is quiescent and the second that improvement has been maintained.

When a case of tuberculosis is reported in a school, the school health service should carry out a survey of the contacts who, according to the circumstances of the case, may include a single class, a group of classes or a whole school. Tuberculin testing by the multiple puncture method is applied and is followed by radiographic examination of the positive reactors. In some areas this procedure has been extended for the purpose of case finding to children not at special risk and testing is offered to school entrants, to other age groups or to whole school populations.

BCG VACCINATION. In 1953, sanction was given by the Ministry of Health and the Department of Health for Scotland for any local authority to make BCG vaccination available to secondary school pupils for the purpose of fortifying them for their encounters with infection after leaving school, and, in order to allow of subsequent supervision in school, the age group selected was the thirteen year olds. The signed permission of the parent must be obtained and in most cases is willingly given; a tuberculin test is applied to the skin by the multiple puncture method and negative reactors are vaccinated. Positive reactors whose sensitivity is the result of a previous exposure to infection and not of previous vaccination may have active tuberculosis at the time of testing or may develop it later. All such reactors, therefore, should be X-rayed, and X-ray examination should be repeated annually throughout school life.

In 1961, permission was granted by the central authorities to advance vaccination to as early an age as ten years if, in the opinion of a local authority, circumstances in its area made that action advisable.

School Dental Service

The statutory duties of this service are laid down in the Education Acts of 1944 and 1962, amended by the Education (Miscellaneous Provisions) Act, 1953, and its function is to secure that the greatest possible number of children leave school free of caries, with good occlusion, adequate masticatory efficiency and healthy gums, to provide immediate emergency treatment for all, and to instruct every child, from the earliest possible age, in the care of the mouth and teeth.

The financial status of the school dental officer remained unaffected by the National Health Service Acts and the attraction of a higher income in the new general dental service induced many to resign and enter practice. Subsequent improvement in salaries has helped to some extent to repair the deficiency and the number of school dental officers is now equivalent to 1,215 in England and Wales and 192 in Scotland, but in all areas the school dental service is hampered by the lack of staff.

EXAMINATION AND TREATMENT. Routine examination is carried out in the schools. Treatment may be provided in school but more often and more efficiently in the school dental clinic, and in rural as well as in some urban areas use is made of the mobile dental van, a fully-equipped dental surgery on wheels. Even in the most favoured area too much of the dentist's time is still of necessity occupied with extractions and the relief of pain, and this should not be allowed to obscure the fact that the work of the service covers the whole range of dental activities. Increasing importance is accorded to orthodontic treatment, many authorities providing for the services of part-time or whole-time specialists in that subject. Dentures are provided free of charge to school children.

Parents who prefer to make their own arrangements for treatment by family dentists are, of course, at liberty to do so, and the British Dental Association has put forward, as suggestions for the greater use of the general dental practitioner to relieve the shortage of school dentists, that the control of the school dental service should be transferred to the Ministry of Health; that school dental officers should examine but should refer to practitioners all cases needing treatment; that practitioners should be engaged in school work on a sessional basis; and that children having appointments with practitioners during school hours should be able to keep these appointments without losing their school attendances. The last two suggestions have so far been adopted to a limited extent and the first two have not proved acceptable.

DENTAL HEALTH EDUCATION. This is the most effective instrument for securing good oral hygiene and dental officers take every opportunity to give instruction in the care of the mouth to individual children and parents, to groups and classes in school and to parents' associations. In order to extend this work a scheme was inaugurated in 1949 for the training of a body of auxiliaries to be called dental hygienists.

Dental Hygienists. The course of training extends over nine months and the curriculum is comprehensive. The main functions of a dental hygienist are to scale and polish the teeth, to carry out certain preventive treatments and to teach the technique and practice of oral hygiene. Courses of training are carried out in six dental schools, in the Air Force and in the Army Dental Corps. Hygienists work under the supervision of registered dentists and a number are employed in the school dental service, where they have been found to be of value not only in giving advice in the care of the mouth to individuals, groups and classes, with the use of visual aids such as models, films, film-strips and flannelgraphs, but also in the introduction to dental treatment of apprehensive patients. It has been found that one or two appointments for cleaning and polishing by the hygienists enable further appointments with the dental officer to be accepted with confidence, and valuable time may thus be saved.

The New Zealand Dental Nurse. The dental service in New Zealand was for long unique in that its work is, in the main, carried out by school dental nurses. The New Zealand dental nurse receives an intensive training lasting two years and at the end of that time is fitted to undertake both preventive and remedial treatment. Preventive treatment includes 'prophylactic odontotomy', the name applied to the process of cutting out the fissures in the surface of molar teeth in very young children and filling with amalgam. Remedial treatment consists of the filling of deciduous and permanent teeth and extraction of deciduous and permanent teeth under local anaesthesia. Much attention is paid during the course to training in dental health education. The New Zealand nurse undertakes the responsibility for the dental care in her area of pre-school and schoolchildren up to the age of twelve, under the supervision of a small number of dental officers to whom, or to private practitioners, she refers children requiring treatment which is outside her training. The number of children allotted to each nurse is 500. Dental clinics are situated in the schools and with each clinic is associated a local clinic committee consisting of representatives from local organisations and private individuals. A substantial part of the nurses' time is given to health talks in school, to chair-side instruction, and to health education by the use of posters, murals and other visual aids. Treatment for older children is provided under the 'adolescent service' which will eventually be staffed by salaried dental officers, but in which at present a number of private dentists participate on a fee-for-service basis.

The employment of dental nurses was introduced into New Zealand in 1921. Similar schemes were set up in 1949 in the Federation of Malaya and more recently in Burma, Hong Kong and elsewhere in the Far East.

Dental Auxiliaries. Critics of the dental hygienist in this country have always maintained that her training and range of duties are too restricted to be fully useful and have recommended the introduction into the school dental service of a more highly qualified dental auxiliary. The Dentist's Act, 1956, therefore, made provision for an experimental scheme of training for dental auxiliaries resembling that which is given in New Zealand and in 1960 a training course was introduced in New Cross Hospital, London, which occupies two years. Sixty students are admitted to training every year and those who successfully complete the course are qualified to carry out the filling of deciduous and permanent teeth and the extraction of deciduous teeth under the supervision of the school dental officer. These dental auxiliaries also undertake dental health education among schoolchildren, parents and groups such as youth clubs and parents' associations.

Environmental Activities

Environment. The Building Regulations of the Ministry of Education and the Scottish Education Department issued in 1945 prescribed standards for sites, playgrounds, playing fields, classrooms, staff rooms, cloakrooms and lavatory and sanitary provision. Lighting, heating, ventilation, water supply, and drainage were also dealt with. Because of the need for national economy, subsequent amendments have to some extent lowered the standards set by these regulations, but even this lower level is incapable of attainment in many older schools both in town and country, and not only may the well-being of pupils be affected by grave deficiencies, but the teaching of the elementary rules and habits of health may be stultified.

School medical officers are specially concerned with those factors in environment which have a direct influence on the health of the pupils. As early as 1908 the Board of Education suggested that school medical officers should report annually on the hygienic conditions prevalent in schools in respect of ventilation, lighting, warming equipment, sanitation, etc., and the Scottish Act of 1962 lays a statutory duty on them to inspect and report on school premises, furnishing and equipment, having special regard to lighting, heating, and ventilation and to sanitary arrangements. A particular problem which closely concerns the school nurse, and of which the importance has been greatly increased by the raising of the school-leaving age, is the supply and disposal of sanitary towels and the personal hygiene of girls in secondary schools and also in the higher classes of primary schools. Much discomfort and unhappiness result to the adolescent from inadequate provision.

Provision for school meals and milk. In London, in 1882, a survey of schoolchildren revealed that 10 per cent were 'too hungry to learn'. Because of the association between hunger and failure to benefit from education, the introduction of free meals for children from poor homes, was, in many countries, an early development in the care of the schoolchild, and since the second world war the provision of school meals has in most countries been greatly extended. For instance, in the urban areas of Denmark, despite restrictions imposed for economic reasons, 44 to 60 per cent of school children take part in school meals. The meal takes the form of a lunch which covers one third of the child's caloric requirement, and half his requirement of mineral salts and vitamins, and which consists of a quarter of a litre of milk, and a packet of sandwiches containing egg and potato, cheese, fish, butter and tomato, and other suitable fillings.

The earlier development in this country of the school meals service will be found in Chapter 11. The English Act of 1944 and the Scottish Act of 1962 make it obligatory for local education authorities to provide milk, meals and other refreshments for pupils in attendance at maintained schools. Unlike the 'Oslo' breakfast or the school lunch of continental countries, the school dinner in Great Britain, is, as a rule, a cooked meal. In most areas it is still prepared in a central kitchen, and sent out by motor van to be consumed in the dining centres of neighbouring schools, and the delay between cooking and serving, inevitable under such a system, affects both the palatability and nutritive value of the food.

This is avoided if each school has its own kitchen and for a time the provision of school kitchens instead of central kitchens proceeded with promising speed. Later, however, the need for economy slowed down this development.

The school dinner provides a minimum of 500 to 800 calories according to the age of the children and is planned to contain 20 to 25 grammes of first-class protein and 25 to 30 grammes of fat with an adequate quantity of minerals and protective foods. Special dietaries are provided for nursery schoolchildren. In addition to supplying a very considerable part of the daily food requirements the school dinner introduces the children to a variety of wholesome foods which many of them never taste in their homes. Much opposition, the result of preformed food habits, has often to be overcome, but in the end those pupils who take school meals acquire a knowledge of, and liking for, a considerable range of food dishes, an experience which, it is hoped, will help to fit them as parents in the years to come to provide for the proper feeding of their families. A school meal, too, provides valuable lessons in the simpler social graces which should be practised at the dinner table.

A charge is made to the parent which covers part of the expense of the meal, the remainder of the cost being met out of the rates. The total cost at present is in the neighbourhood of two shillings, the usual charge is one shilling and if the family income is below a certain level the meal is provided free of cost to the parent. In England and Wales pupils taking dinners number some 3,850,000, representing 59 per cent of those in attendance. In Scotland 330,627 (39·3 per cent) take dinners.

Suitable dining accommodation is found in schools of more recent construction, but in the older schools meals may have to be taken in assembly halls, gymnasia, classrooms or even corridors. Washing-up accommodation, too, may be cramped and inconvenient. There should, therefore, be close co-operation between the school health service and the organiser and staff of the school meals service, and it is a good practice for school doctors to inspect cooking and dining centres on their periodic visits to schools, and to advise the staff on matters of hygiene.

The Milk in Schools scheme. In England and Wales welfare milk (one pint a day at 4d. a pint) is provided for young children to the age of five years. Between the ages of five and eighteen years every child on the roll of a school is entitled to one-third of a pint of milk a day, supplied in an individual bottle from which it is sucked through an artificial straw. The school milk is provided by the education authority and paid for by the Ministry of Food. In Scotland, welfare milk is provided up to the first commencing date after the fifth birthday and education authorities have powers to provide school milk for children who have attained the age of five pending their admission to school. 98·9 per cent of the milk provided is pasteurised and, 82 per cent of the children take school milk in England and 89 per cent in Scotland. For pupils in day or residential schools for the delicate and the physically handicapped the daily quantity is raised to two-thirds of a pint.

Full-cream dried milk, reconstituted, may be supplied where circumstances make the provision of liquid milk impracticable. Geographical reasons make the supply of liquid milk especially difficult for certain Scottish authorities which administer areas where schools are isolated in island communities or scattered over wide tracts of hill country. In England, but not in Scotland, tablets of compressed dried milk, suitably flavoured and sweetened, may be provided instead of reconstituted dried milk.

Cheap Milk for Home-bound Children. Children who are unable to attend school by reason of permanent mental or physical disability receive up to the age of sixteen years a special allowance of milk amounting to seven pints weekly at 4d. per pint if application is made by the parents.

Clothing and footwear. Under powers conferred by the most recent legislation, a child whose clothing or footwear is inadequate may be clad and shod by the education authority to enable him to take full advantage of the education provided at school. The parent may be required fully or in part to reimburse the authority for the expense incurred.

Spectacles. The National Health Service provides free glasses for children, but will not replace them if they have been lost or broken through lack of care. Under that section of the 1944, or in Scotland the 1962, Act which lays on local authorities the duty to secure the provision of free medical treatment for school children, some education authorities pay for spectacle replacements responsibility for which is not accepted by the National Health Service.

Games and physical training. Organised games, and formal physical training, by set gymnastics and semi-military exercises were for long an integral part of the educational system, but already before the second world war there had been some reaction against the fetish of games in public and independent schools, and a steady increase in the facilities for teaching games and swimming in state-aided schools throughout the country. In the years immediately following the war, a notable change took place in the field of physical education, particularly in the primary schools. 'Drill' was discarded, instruction became less formal, and provision was increasingly made for individual activities in which climbing, heaving, balancing, jumping, and other whole-body movements were employed. The result has been a marked improvement in the quality of movement, and in the standard of physical skills. At the same time, in both primary and secondary schools, greater provision was made for a variety of indoor games; for swimming, and for athletics—a branch of physical education previously often neglected because it lacked the popular appeal of other sports.

School schemes of physical education have always included movements designed to assist normal development and correct tendencies to faulty posture. When defects are established however, successful treatment calls for more specialised remedial exercises, practised in small groups, and group remedial treatment forms a large part of the work of a school physiotherapy clinic. This load can be lightened by the organisation in schools of remedial classes under qualified physical training instructors co-operating with the school medical officer, and this is now the practice in many areas.

The advice of the school medical officer is frequently required with regard to exercise and particular activities, such as swimming, in individual cases, and also as to physical training generally in the school curriculum. It may be necessary for him to satisfy himself with regard to the cleanliness of swimming baths, and take steps to prevent the spread of epidermophytosis and plantar warts in bath houses; to make sure that tinea and impetigo are not being spread by the indiscriminate use of towels and changing clothes; and to exclude from swimming children with running ears or other infective discharges. When the school has a gymnasium, he should be satisfied that it is kept clean and properly ventilated. Attention should be paid to under-developed and weakly children who are liable to be over-exercised by a too enthusiastic instructor.

It is equally important that the doctor should not be too anxious to exclude children from physical activities unless he is certain that their condition warrants it. For example, a child who has had growing pains and has a systolic murmur may be turned into a real invalid, with the classical picture of 'effort syndrome' by a doctor who has played for safety by excluding him from all activity in the absence of an organic heart lesion. Even in cases where a physical disability is present, the aim should be to encourage the full range of activity which the child can carry out without suffering further injury. This is well seen in certain cases of well-compensated heart disease, where graduated activity under careful supervision will give a better functional result than complete rest.

Accident prevention and first aid provision. In his general supervision of school premises, the school medical officer concerns himself with such matters as fire precautions, the guarding of machinery in technical workshops and the prevention of burns and scalds in laboratories and domestic science rooms. He also supervises the provision and maintenance of first aid boxes, and advises headmasters, janitors, and groundsmen on the procedure to be followed if an accident occurs in the school, the playground, or the playing field.

Residential camp schools. The purposes of these camps are three in number. The first is to provide for children, mainly from the towns, the chance of becoming acquainted with the countryside and its way of life; the second is to improve health and well-being by residence in wholesome surroundings with good food and regular hours; and the third is to afford the experience of membership of a community and so to develop right qualities of mind and character.

The term 'Camp' tends to mislead, for, in fact, the buildings are substantial wooden chalets with classrooms, assembly and recreation halls and a dining hall and kitchen and each accommodates up to 240 children and some 15 teachers and attendants. Camp schools are owned and managed by the education authorities in whose areas they are situated. It is true that a few are occupied for periods of nine months to a year at a time by delicate or educationally subnormal pupils and in them provision is made for 100 to 120 children only, but the primary concern of the camps is with ordinary pupils and they should not be looked on as special schools for the handicapped. Where classes, or whole schools, are sent to them for periods varying from some weeks to a year, the improvement gained in body, mind, character and social training, is often very great. When not occupied by schools, the camps may be used as holiday centres, or for conferences by national or international youth organisations. In Scotland camp schools are owned and managed by the Scottish National Camps Association, from which they are rented for residential school purposes by local education authorities.

Councils of physical recreation. These have as their purpose the encouragement of young people all over the country to spend part of their leisure time in games, sports, outdoor activities and other forms of physical recreation. The Central Council maintains four, and the Scottish Council two, national recreation centres where, in addition to instructional and holiday courses for students and other adults, school courses are provided for pupils between the ages of fourteen and eighteen years. These are concerned with a very wide range of games and athletics and with such outdoor pursuits as field studies, rock and snow climbing, pony trekking, sailing and camping. Under powers given to them by the current education acts, education authorities may send groups of pupils for periods, usually of a week, to those centres, paying part or the whole of the expense involved.

Outward Bound schools. The Outward Bound Trust, founded in the early years of the second world war, conducts training courses for young people between the years of fourteen and a half and nineteen and a half. These courses, whose primary purpose is to provide character building opportunities which are often lacking at school, work and play, last twenty-six days and are held throughout the year at two mountain, two moorland and two sea schools. The training is planned for boys and girls of ordinary physical fitness and embraces athletic tests, expeditions demanding initiative and endurance, and practical tasks in seamanship and mountaineering, and also includes talks and debates on subjects of interest in which all are encouraged to take part. Short though the course is, the experience has a remarkable effect on the character and also on the health of many who participate, and education authorities make grants to enable pupils from secondary schools under their management to attend the outward bound schools.

Courses on outward bound lines are now held in other countries of the Commonwealth and in Western Germany.

The Duke of Edinburgh's Award for boys and girls. This scheme, when initiated in 1956, was restricted to a small number of experimental local authorities but it has now been extended to cover the whole country. The Award Scheme is not a competition and the standards for each test are intended to match average abilities; perseverance is one of its key-notes. No one need be debarred because of physical or material handicap. The purpose of the scheme is the encouragement of young people to find happiness in new interests; the development of their talents for the service of the community; and, above all, the building of character. Boys and girls may enter for the awards between their fourteenth and twentieth birthdays, and there are three stages—the preliminary, which leads to a bronze, the intermediate, which leads to a silver, and the final, which leads to a gold Award Badge. In each stage there are four sections—for the boys: Fitness, Rescue and Public Service Training, the Expedition, Pursuits and Projects; and for the girls: Design for Living, Interests, Adventure, Giving Service. Many education authorities have introduced the scheme into their schools and they are empowered to help participants by the loan of camping equipment; by payment of fees for residential training; by the provision of instructors for specialist courses; and in other practical ways.

Health Education

In 1919 the newly created Ministry of Health, in issuing its outline of purpose, emphasised, among other requirements of a national health policy, the need for public education in hygiene. It is true that instruction of parents, and also of children, in the principles of healthy living has always been a basic function of the local authority health services especially of the maternity and child welfare departments, and great has been its effect. But those services reach only a fraction of the people, their opportunities for instruction are intermittent, and it would appear that universal instruction in health over a long period of years can best, and indeed can only, be provided in the world of school.

Ever since the school medical service was started in 1907 the need for health education has been stressed in successive report on 'The Health of the School Child' and health teaching has for a considerable number of years been a feature on the curriculum of many schools. But it has varied widely in amount, quality, and effectiveness, and in order to stimulate and to standardise instruction, the Board of Education in 1928 issued its 'Handbook of Suggestions on Health Education'. In 1945 the Central Council for Health Education published a pamphlet on 'Health Education in the School' and in 1950 the Scottish Council for Health Education produced its 'Report on Health Education in Schools'. This report, which is worthy of study by all who are interested in the subject, after a brief description of the position today and of certain pilot experiments in three Scottish cities, puts forward its recommendations, along with suggestions and detailed model syllabuses for teachers.

'It must be emphasised that education in health means far more than lectures, classroom exercises, and planned formal instruction. Health knowledge and health practices are acquired more easily and become a part of a child's equipment for living when they have been gained through real experience in personal care and community hygiene during the school years. The example of adults and the healthfulness of the daily environment are potent educational influences.'

With this principle in mind, those who plan health education must direct their attention first to the provision of clean, well-equipped and hygienic schools and playgrounds; next to the inculcating of healthy habits through daily practice and example, from the first day on which the child enters school; and lastly to the gradual introduction of formal teaching in health matters.

Teachers, well-grounded in the relevant principles, are, or should be, the principal source of health instruction but the school health service has a part to play which can be undertaken by no other agency. Every opportunity should be seized by medical officers and nurses to advise children and parents, as individuals or in groups, at routine or other medical inspections, on the essentials of healthy living. More detailed explanations of specific subjects can be given to classes in secondary schools and also to parents' associations, with liberal use of visual aids, and the advice of the medical officer and nurse should at all times be available for the guidance of the teacher. The principles and aims of health education, including sex education, are considered more fully in Chapter 19.

Domestic Science and mothercraft instruction. Education authorities attach increasing importance to the teaching of domestic science and housewifery to older girls, and in many secondary schools, in addition to the cookery, laundry and sewing classrooms, a model flat is attached to the housewifery department where older girls take turns to stay in residence and learn home management under a resident mistress. Education authorities also make arrangements for the teaching of mothercraft to senior girls, either by school nurses or by health visitors provided by the maternity and child welfare services, instruction being given to the girls in small groups by lecture-demonstrations in school and by visits to day nurseries. Teaching of mothercraft is supervised by the school medical officer.

Instruction in accident prevention. Injury resulting from accidents is a common cause of absences from school, and accidental deaths now form a quarter of all deaths in childhood. Of the total number of accidents reported 25 per cent occur in the home and 50 per cent on the roads and health education in school is, therefore, directed to the prevention of accidental injury in both of these places.

Avoidance of home accidents is rarely the subject of formal instruction but it is incorporated in the ordinary work of the domestic science classrooms, the technical work-shops and the science laboratories in secondary schools, where pupils are taught the prevention of burns and scalds, the precaution needed to avoid accidental poisoning with cleaning agents and medicinal substances and the proper use of edged or pointed implements and of electrical and other equipment. When a 'flat' or 'house' is part of the domestic science department, there is a still wider field for teaching the secondary school girl to avoid mishaps in the home.

Training in road safety on the other hand is suitably given by more formal methods and it is recommended that in primary schools a few minutes be given to this instruction by class teachers once a week for older children and thrice a week for younger children, for whom the instruction includes 'kerb drill'. In many areas playground demonstrations are regularly arranged, equipment being provided by the Education Authority, the demonstrators being traffic policemen with motor cycles and the children themselves playing an active part. Accidents to child cyclists occur most often at twelve to thirteen years, the age at which a bicycle but not always the skill to ride it properly is acquired, and Education Authorities may arrange in their secondary schools for traffic constables or other experienced persons to examine bicycles, point out defects, advise on maintenance and give instruction to young cyclists in the school playground. Children who have received this instruction may be put forward for official test by the Royal Society for the Prevention of Accidents and those successful receive the 'Safe Cycling' badge of the Society.

Instruction in health education. In other countries, notably in the United States, pedagogical specialists trained in the principles of health and hygiene, and also in the methods of presenting these principles to children and adults, are employed as 'Health Educators', but this degree of specialism has not been developed in Great Britain. All student teachers in training colleges and university training departments, however, receive instruction in health education, many of the colleges having incorporated in their syllabus the suggestions made in the Board of Education's Memorandum (1943). School nurses, in their course of study for the Health Visitor's Diploma, also receive theoretical and practical instruction in the subject. In 1954 the University of London Institute of Education initiated a comprehensive course on the content and method of health education which lasts nine months and leads to a diploma of the Institute and which is intended for doctors, nurses, teachers and other suitable students.

Employment of School Children

In general, the effect of the provisions of the Children and Young Persons Act 1933 (Scotland 1937) as amended by the Education Act 1944 (Scotland 1962) is that a child may not be employed until he is thirteen years of age. From then until he reaches the upper limit of compulsory school age he may engage in part-time employment out of school hours but not in an 'industrial undertaking', that being prohibited by the Employment of Women, Young Persons and Children Act, 1920. In the eyes of the law a person is employed when he assists in a trade or occupation carried on for profit, and the provisions, therefore, apply as much to the child helping a parent or relative to carry on a business, as to the child earning payment for his services.

The delivery of milk and newspapers and miscellaneous duties in shops and on farms provide employment for the great majority. The provisions of the Act, and of the bye-laws issued by local authorities, define and restrict the nature, hours and conditions of work done outside school hours by these children, and a bye-law, now commonly adopted, lays down that the child shall be examined by the school medical officer before a licence for employment is granted. Very many boys and girls in modern and junior secondary schools earn money by part-time occupation without detriment to their health or their education, but pupils in grammar and senior secondary schools with heavy educational commitments should not undertake this work. If, after part-time employment has been undertaken, it appears that the child's health or education is adversely affected by it, the local authority has the right to prohibit the child's employment.

EMPLOYMENT AS FILM ACTORS AND IN THEATRICAL WORK. Special provisions relating to employment in entertainments make it possible for children to undertake theatrical work after the age of twelve in England, and fourteen in Scotland, if a licence has been issued by the local education authority. No licence may be granted unless the authority is satisfied that the child is fit, and that proper provision is made to secure his health, and his educational and moral welfare, and the child must be examined by the school medical officer before being licensed, and thereafter at three monthly intervals.

The majority of licensed children appear in troupes, especially in pantomime troupes, but a small number play individual child parts in the theatre. Two-thirds of the licences relate to children living at home and playing in local theatres, and one third to children on tour. With few exceptions, children taking part in entertainments drop back in their schooling, but they rarely show evidence of deterioration of health or of emotional disturbance. The employment of children in film work is governed by the general restrictions on the employment of children.

EMPLOYMENT OF YOUNG PEOPLE. The Employment and Training Act, 1948 empowers any local education authority to provide a youth employment service, and 129 of the 183 authorities have accepted this responsibility. In the other areas the service is administered by local officers of the Ministry of Labour (see Chapter 16).

Nursery Schools

Chapter 11 describes the earlier growth of the nursery school movement in this country. Official recognition of the value of nursery schools was accorded in the provisions of the Education Act of 1918, yet in 1937, not more than 87 nursery schools, for children between two and five years of age, were recognised by the Board of Education (now the Ministry of Education) of which 47 were maintained by voluntary agencies and only 40 by local authorities. Local authorities, however, provided for children from the age of three years some 180 nursery classes attached to infant departments in elementary schools. Nursery Schools, being classified as 'Special services', received a full measure of care. This included open-air buildings, a school routine with well-planned meals and sleep, and close medical supervision. Nursery classes, on the other hand, were part of the elementary school system. In some it was possible to achieve standards similar to those in nursery schools but most were housed in ordinary schoolrooms, received no regular medical inspection, and were closed at noon for two hours. In consequence, neither school meals nor sleep were part of the routine.

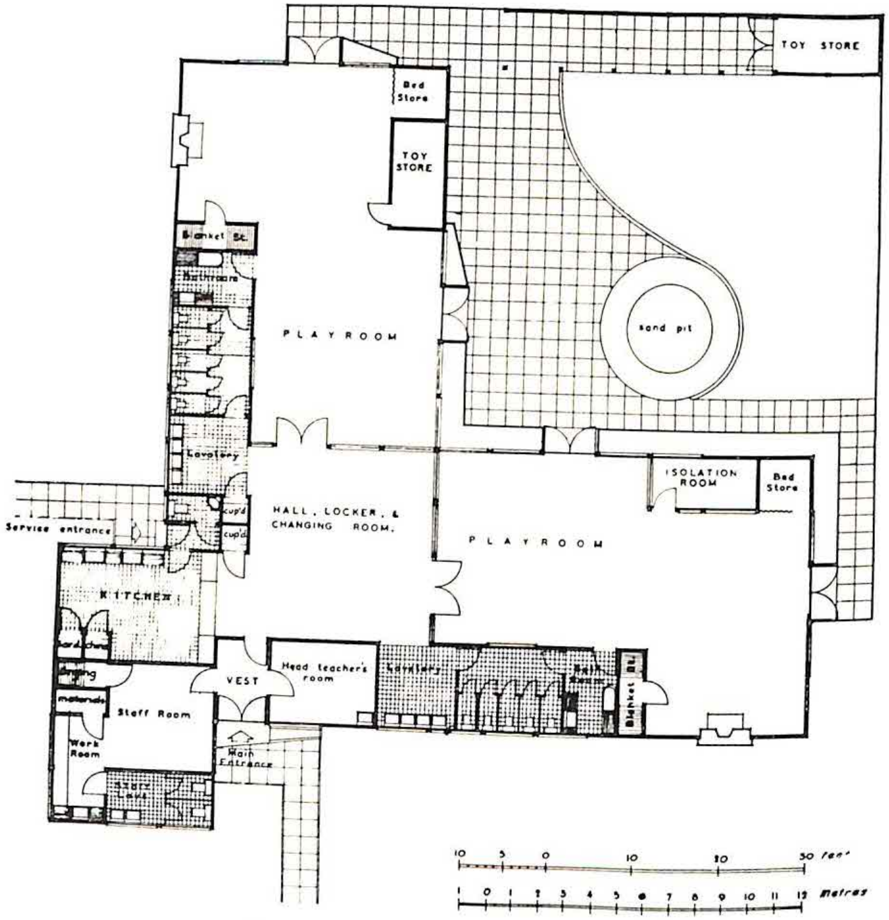

FIG. 73. Plan of a Nursery School.
(Courtesy of the City Architect, Edinburgh)

On more than one occasion the annual report of the Chief Medical Officer of the Board of Education drew attention to the higher standard of health in the nursery school as compared with the nursery class. Since the coming into force of the most recent legislation, this substantial difference in status, daily routine and effect on the child, no longer exists, for the English and Scottish Education Acts of 1944 and 1962 established nursery instruction as an integral component of primary education and put nursery schools and classes on the same footing.

The impetus given by this legislation to the provision of nursery schools and classes was unfortunately soon checked by the demand for economy in the educational services, and since 1948 there has been little provision of new accommodation. The number of full-time nursery schools (excluding special schools) is at present 549 and the number of full-time nursery classes is 2,234.

Accommodation and administration. Some nursery schools and classes reach a very high standard in building and equipment. Others are housed in adapted premises which leave a good deal to be desired. The most suitable unit is a group of 20 to 25 children, and the most suitable nursery school, from an educational point of view, is one built to accommodate two units. The problem of expense, however, makes this ideal difficult to achieve and the basic unit in many schools is, therefore, 40 pupils. Each unit should have its playroom, which is also used as dining and sleeping room, its cloakroom, lavatories and washroom. A covered veranda and ample outdoor space for a garden, play-space, sand-pit, etc., are needed so that the children may spend as much of their waking and sleeping time as possible out of doors. The accompanying plan of Calderglen Nursery School (Fig. 73), designed by the City Architect, Edinburgh, makes accommodation for two classes of 40 pupils each. By means of light, rigid, movable screens each classroom can be divided into two equal or unequal subsections and the classes can be broken up into groups.

A nursery school is under the charge of a headmistress, who must be certificated and who holds an extra qualification for nursery school work. She is assisted by other, similarly qualified teachers; by nursery assistants, usually women over eighteen years holding a certificate in nursery nursing, and by nursery students. The last are girls between fifteen and eighteen years following a two years' course of training which leads to the certificate in nursery nursing.

A nursery class is a component of a primary school, is normally housed in the same building and is under the immediate charge of the infant mistress and ultimate charge of the head teacher. In accommodation, amenities, and staffing, it should conform as closely as possible to nursery school standards. Nursery classes should always have their own playgrounds, lavatories and washrooms. In England the age of the nursery school child is two years to five years, and of the nursery class child, three years to five years, but if there are exceptional circumstances, a child may be admitted to a school before two years and to a class before three years and may be retained after five years. If a nursery school is approved for the purpose, pupils may be retained to the age of seven years. In Scotland, children enter both schools and classes at the age of two years and may remain until five-and-a-half years. Retention after the age of five-and-a-half years requires the sanction of the Secretary of State.

In the United States, the nursery school was instituted mainly as a laboratory for psychological research in a middle-class setting. In Britain, on the other hand, it was developed by the McMillans and other pioneers as a remedial service for children who were the victims of slum life, and, as late as 1936, the Board of Education stated that nursery schools had, as their primary object, the physical and medical nurture of the debilitated child. Supporters of the nursery school, however, have come increasingly to realise that, in its normal function, the school should provide for the young child irrespective of social circumstances and as part of the country's ordinary educational system. In supplying the right educative environment for growth, mental, emotional, physical, social and spiritual, it should be complementary to the home and neither a substitute nor yet a rival. A child has the best chance of healthy development when he spends his life in surroundings in which he feels safe and secure, in which duties and pleasures succeed one another according to a routine he can understand and in which he knows that all is ordered by some sympathetic and understanding grown-up. It is the purpose of a nursery school to provide those surroundings and, at the same time, to enable the child to enjoy and profit from the companionship of children of his own age. A typical day's programme may be outlined as follows:

9.00 a.m.—11.30 a.m.: Children arrive and are received by staff.
Throughout the morning there is a choice of play or individual and group occupations indoors or out of doors. Mid-morning snack.

11.30 a.m.—12 noon: Toilet, and preparation for dinner.
12.00—12.45 p.m.: Dinner.
12.45 p.m.: Preparation for sleep.
1 p.m.—2.30 p.m.: Sleep. Towards the end of this period older children may resume individual or group occupations of a quiet nature.
2.30 p.m.—3 p.m.: Free play and group occupations.
3 p.m.: Afternoon snack. Preparation for home-going.
3.30 p.m.: Children depart.

Within the framework of this timetable, the largest amount of time possible should be allowed for play, the child's activities being pursued at his own pace and varied in the main according to his own choice.

The equipment in a nursery school need not consist of expensive toys. There is, on the contrary, much virtue in ordinary things of common household use and in simple robust objects such as waste material from timber yards and factories. The equipment should provide the things which make play possible in many forms and this play may be grouped in three main categories.

Play in Which Use is Made of the Muscles, especially the large muscles, in which experiments are made in large movements of trunk and limbs, and which necessitates the surmounting of some obvious physical difficulty. Planks, logs, old motor tyres, barrels, and large wooden boxes provide inexpensive material for this kind of play. Steps, slides, safety-swings and 'jungle-gyms' are also often supplied.

Constructive Play, which requires materials such as water, sand, and clay, and objects such as bricks, boxes, beads, string, buckets and spades. Older children make use of toys such as motor cars, aeroplanes, farm-yard animals, etc. In satisfying his desire to make, create, and manipulate, the child develops concentration and experimentation, gains manual dexterity and discovers the properties of his material.

Imitative Play and Imaginative Play. Much time is spent in playing at being other people: fathers, mothers, teachers, nurses, postmen, and other well-known persons, and in reproducing the activities of home life; cooking, mending, and looking after dolls. With equal enjoyment, children assume the part of birds and beasts, of motor cars and aeroplanes, or lose themselves in such imaginative play as Red Indians, shipwrecks and desert islands. It is held by many that a young child can fully grasp an idea only by acting it out in this way for 'what he tries to represent or do, he begins to understand'.

Younger children, and older children when they first join the school, prefer, as a rule, to play by themselves. Later they like to play beside one another and finally to play with one another in pairs or small groups. Larger groups, with the help of grown-ups, form to enjoy singing, dancing, or story-telling and to take part in some communal activity outside the school precincts. Even a simple walk through streets or park can be full of interest and enjoyment if it has some definite objective and is made under the care of a sympathetic nursery nurse or teacher.

It is a fundamental principle of nursery education that the child should be left to do, and encouraged to do, as much for himself as possible. The capacity to do so varies enormously according to the age as well as the personality of the child. Members of the staff must know when not to proffer help and advice and they must also be ready to provide a sympathetic ear, a patient answer to questions and practical help with activities when this is really needed. The child's fundamental need of movement and play both for happiness and for learning as well as for physical and social development is now recognised by all nursery school workers. It was appreciated in this country as long ago as 1816, when Robert Owen, 'following the plan prescribed by Nature', opened a school where young children were to dance and sing, to learn when their curiosity induced them to ask questions and not to be 'annoyed with books', but the German educational reformer, Friedrich Froebel (1782–1852), is the acknowledged source from which were spread, not only the knowledge of the importance of play, but many of the principles on which nursery school life nowadays is based. Much of Froebel's, method is inculcated in training colleges throughout the country. There are moreover, Froebel training centres whose teaching is in full and recognised accordance with his principles.

Since the turn of the century nursery school life has been influenced by the work and writings of the Italian physician and educationist Maria Montessori. As doctor to a clinic for imbecile children in Rome, Dr. Montessori became interested in the education of the mentally defective and acquainted herself with the methods used earlier in the nineteenth century by Edouard Séguin, a pioneer in that field. Séguin had introduced a 'physiological method of education' for defectives founded on training of the sense organs and the practice of carefully chosen muscle movements. On this basis, Dr. Montessori established a method of education for ordinary children by the use of specially designed apparatus and equipment. She also insisted on freedom from rigid timetables and other restrictions and stressed the importance of individual learning.

There are zealous disciples of Froebel and zealous disciples of Montessori, between whom disagreement is at times sharp and even acrimonious, but there are few nursery schools in which programme and methods are specialised solely according to the principles of one or other system. The methods employed in most nursery schools are founded on a study of the work of all the earlier educationists in this field, combined with the more modern researches of educational psychologists, and the individual teacher adapts these methods to suit the needs of her particular group of children.

Co-operation with Parents. Co-operation is essential for the success of the school and the welfare of the individual pupils. There is daily contact between teachers and mothers who bring and fetch their children. Meetings of the mothers' club, held regularly and frequently, are, as a rule, well attended and give opportunity for discussion of the management and welfare of the child. At these meetings, and at home, mothers participate in the work of the school by cleaning, and by making and mending garments, towels, cloths, equipment, etc. At these meetings, too, the mothers get to know one another and parties and social outings are regular activities of the club.

Fathers also are encouraged to participate in the work of the school and many of them gladly give a helping hand by digging, gardening, carpentering and the repairing of toys and equipment.

Promotion of Physical Health. The whole of nursery school life is, by its nature, an education in healthy living for the child, more specific training being given in hand-washing, teeth-brushing, nose-blowing, regular elimination, and proper feeding habits. Moreover, through the partnership between parents and teachers, which is in most cases secured, the lessons of health and hygiene are conveyed to the home. At parents' meetings, as well as in the medical room during inspection of the individual child, instruction is given as to clothing, feeding, sleep, ailments and behaviour difficulties by school doctors and nurses.

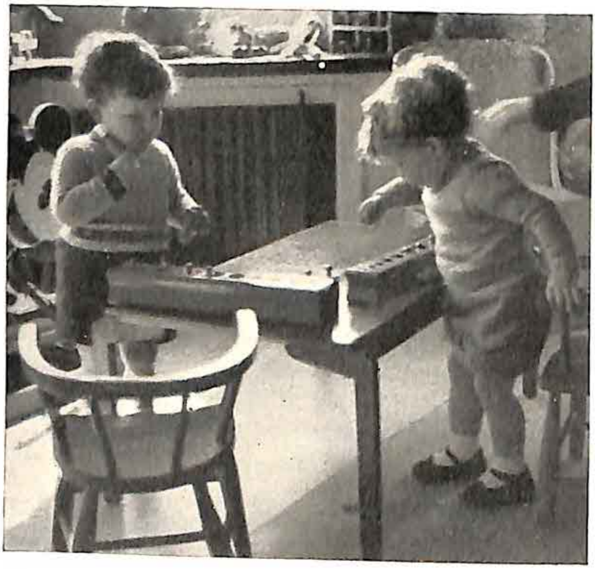

Fig. 74. Nursery school furniture should be of appropriate size, and play material suitable for the intelligence of the children.

Emphasis is rightly laid on the value of activities out of doors but extremes should be avoided. Experiments have been conducted into the most suitable types of protective clothing for nursery children, but the benefit of a hardening process so intense as to require this special provision may be questioned.

Meals are supplied through the school meals srvice. Preferably, they should be cooked on the premises and, as a rule, they consist of a morning snack, a mid-day dinner, and a snack at the end of the school day. The meals are carefully planned to introduce the children to a large variety of wholesome foods and should be served as attractively as possible. Practice is acquired in the use of forks, spoons, and crockery, and in good table manners, and the serving of their fellows is looked on as a prized privilege of the older children.

The after-dinner sleep, which, whenever possible, should be enjoyed in the open air, is an important part of the day's routine. Many nursery school-children suffer from constant deprivation of rest and sleep, and they quickly accept the sleep habit at school and make up, at least in part, for what they have lost at home.

The risk of infection is minimised by the division of a school into units, by the use of individual face cloths, towels, combs, tooth mugs and brushes; by the provision of adequate floor space; and by insistence on fresh air.

Medical supervision is the responsibility of the school health service whose consultative and treatment facilities, including those of the dental service, are available to nursery schoolchildren. Frequent, it may be daily, visits are paid by the school nurse and frequent inspections made by the school medical officer. In Scotland, under the instructions issued yearly to school medical officers by the Department of Health, all nursery pupils must be inspected on admission.

RESIDENTIAL NURSERY SCHOOLS. A number of education authorities maintan residential nursery schools in country surroundings. Others make use of holiday homes in which pupils from day nursery schools in town spend holidays of duration varying from a few days to four weeks under the charge either of their own teachers or of the staffs of the homes. Medical supervision is provided, either by the school health service or by local practitioners.

NURSERY SPECIAL SCHOOLS AND CLASSES. Early training in expert hands is necessary for children with certain handicaps. In England and Wales, therefore, nursery instruction is provided in five schools for the blind; in 23 schools for the deaf; in 16 schools for the delicate and physically handicapped; in one for the educationally subnormal and in one for the maladjusted. There are nursery classes in a number of hospitals. In Scotland two schools for the blind, six for the deaf and three for the physically handicapped accept children of nursery age.

Experimental Developments

THE PART-TIME NURSERY SCHOOL. In order to supply nursery school training to a larger number of children than that catered for under standard nursery school and class provision, the Nursery School Association has put forward a practical plan for part-time nursery schools. These are organised on the basis of a morning and an afternoon session, providing for two different groups of children between three and five years of age. There being no need to provide for the children's mid-day meal and rest, the number of requirements is reduced and the accommodation is smaller and less costly and the work of a part-time nursery school approximates to that of a Toddlers' Playground, described in the section on Day and Residential Nurseries.

THE NURSERY-INFANT SCHOOL. Children are admitted to a nursery school or class from the age of two years or three years, and, as a rule, they leave at the age of five years, passing on to the infant department of a primary school. The transition is relatively easy for a child in a nursery class which is already a part of a primary school. For the nursery school child, however, the break is complete and from a psychological point of view may be undesirable. Great Britain is unique in enforcing the education of all children at the age of five when many are still very immature and in European countries the age of compulsion is generally six and in some it is seven years. Many educationists hold that no child should be forced to receive formal schooling until the age of seven and, in many progressive infant departments where Froebel or Montessori methods are followed, a child's activities are an extension of those prosecuted in the nursery school. There is, therefore, a considerable body which favours a school for children between the ages of two and seven years, and such schools have been tried on a limited scale and have proved successful.

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Chapter 14

CARE OF THE UNDERPRIVILEGED CHILD

ELLIS (1960) drew attention to the cost to the nation of broken homes in terms of children in care of local authorities and voluntary organisations and showed how little money was being spent in the prevention of family break-up. The Committee on Children and Young Persons (1960) and a special committee appointed by the Scottish Advisory Council on Child Care to investigate the problem of the Prevention of Neglect of Children (1963) both recommended that local authorities should be given statutory powers to take action to prevent the break-up of families. This recommendation was incorporated in Section 1 of the Children and Young Persons Act, 1963, which placed a duty on local authorities, acting through their children committees, to make available such advice, guidance and assistance, including in exceptional cases assistance in kind or in cash, as might promote the welfare of children by reducing the need to receive them into or keep them in care or to bring them before a juvenile court. Prior to the passing of this Act, children's departments of local authorities had no powers to employ their resources or spend any money on preventive work. It had long been felt, too, that more research was needed into the various problems associated with child care, and the 1963 Act gave powers to the Secretary of State for the Home Department and to the Secretary of State for Scotland and to local authorities to conduct or assist in research projects pertaining to child care. Much thought has also been given to the work of children's departments and to their staffing needs, and these aspects have been the subject of reports published by the Scottish Education Department (1963), the central government department in Scotland directly concerned with child care. A reassessment of the different methods of looking after children in the care of local authorities and voluntary organisations has been engaging the attention of children's officers and others in the field of child care (The Needs of Young Children in Care, 1964), and particular attention has been paid to the vexed question of choice of foster-parents for such children. Trasler (1963) discusses very fully the techniques adopted for the care of deprived children.

Administration of Child Care Service

Under the Children Act, 1948, and the Children and Young Persons Act, 1963, the Home Office has central responsibility for the general supervision of the methods adopted for the prevention of family break-up, the conduct and supervision of research into aspects of child care, and for the care of children deprived in one way or another of normal family life. These children comprise: (*a*) those received into the care of a local authority because they have no parents or guardians or have been abandoned or lost, or because their parents or guardians are temporarily or permanently unable to provide a satisfactory home for them;

(*b*) those children and young persons committed to the care of a local authority by courts under 'fit person' orders under the Children and Young Persons Acts, as being in need of care, protection or control, or as offenders against the law; (*c*) those committed to care under the Matrimonial Proceedings (Children) Act, 1958; (*d*) foster-children under the Children Act, 1958; (*e*) protected children under the Adoption Act, 1958; and (*f*) children in the care of voluntary organisations. Immediate responsibility for the development and provision of preventive measures, for the conduct of local research projects and for the care and supervision of groups (*a*) to (*e*) rests with the councils of counties and county boroughs acting through their children committees and children's officers. Children in (*f*) are the immediate responsibility of the voluntary organisation concerned, but local authorities are required to visit the children in voluntary homes in their areas. In Scotland, central responsibility rests with the Scottish Education Department, local responsibility with the councils of counties and large burghs. Children and young persons are committed to the care of local authorities under 'fit person' orders made under the Children and Young Persons (Scot.) Act, 1937, but the other relevant legislation, including the preventive provisions and the conduct of research under the Children and Young Persons Act, 1963, are largely as for England and Wales.

CHILDREN'S OFFICER. This is the executive officer of the local authority children committee, and who is responsible for the day-to-day administration of the services provided for the various groups of children described above. No prescribed qualifications have been laid down for children's officers, many of whom are women. Most have had a university training and some possess a social science diploma or certificate in child care. They must have administrative ability, work easily with committees, both statutory and voluntary, and have a keen and progressive interest in the welfare of children.

CHILD CARE OFFICER. This term was introduced in 1954 by the Central Training Council in Child Care to denote those individuals who had taken a prescribed training in child care. The course of training includes the principles and practice of:-boarding-out, helping and assisting families in difficulties, supervising foster-children, planning for children needing special kinds of care, juvenile court procedure, adoption procedure and the supervision of protected children. These officers are mainly employed by local authorities but some voluntary organisations employ those with child care qualifications.

THE CENTRAL TRAINING COUNCIL IN CHILD CARE, formed in 1947 and reconstituted in 1962, is concerned with the encouragement and support of courses of training in child care organised by universities and other educational establishments. These training centres grant a qualification to each successful candidate and the Central Training Council in addition gives a letter of recognition as a qualified child care officer. The Council is also actively engaged in the promotion of new specialised courses and details of these are to be found in the Report of the Work of the Children's Department of the Home Office, 1961–63 (1964). Those working in residential nurseries usually sit the examination of the National or Scottish Nursery Nurses' Examination Board.

The whole problem of administration and staffing of local authority children's departments was ably presented in an important report issued by the Scottish Education Department (1963).

The Children and Young Persons Scotland Committee appointed to consider the law of Scotland relating to the treatment of juvenile delinquents, juveniles in need of care or protection or beyond parental control, and the constitution and functions of juvenile courts, in its report (Kilbrandon Report, 1964) made far-reaching proposals for the local re-organisation of the social services for children. It recommended that the present powers and duties of local authorities under the Children Acts and Children and Young Persons Acts should be transferred to education authorities, each of which would have a 'social education department' under the Director of Education. The function of this new department, under a depute director of education to be called a 'Director of Social Education', would be to discharge the functions of the existing children's department, as well as being responsible for the child guidance, school health and school welfare services. The social education department would also administer all existing and future special residential schools provided by the education authority. Juvenile courts, it was recommended, should be abolished and their place taken by juvenile panels with powers to order special measures of education and training for the juveniles concerned, *i.e.*, those under sixteen years. These revolutionary proposals are presently engaging the close attention of all concerned with the many aspects of child care and family welfare in Scotland.

With so many agencies and services, statutory as well as voluntary, existing to promote the welfare of children the National Bureau for Co-operation in Child Care was founded in 1962 with the object of promoting the benefit of children or young persons who are in need of special care. During the first nine months of the Bureau's existence almost three hundred local authorities and other organisations, professional and voluntary, had become members since one of the Bureau's primary functions is to organise co-operation among these many bodies, including the formation of local groups, and to improve the quality of the services available for children.

Welfare Powers of Local Authorities

The problem presented by children neglected or ill-treated in their own homes is essentially a medico-social rather than a legal one. Physical violence as a consistent policy of parents is comparatively uncommon as is culpable neglect shown by starvation and lack of sufficient clothing and shelter, and the law as it stands deals with such cases. More important, however, are the cases where children and young persons suffer and are neglected as a consequence of obvious inadequacy of a family, the so-called problem family, and the less obvious instances where there is failure to establish personal relationships. It is to assist and help such families that local authorities are required, under the Children and Young Persons Act, 1963, to make available such advice, guidance and assistance, including assistance in kind or in cash in exceptional instances, as might promote the welfare of children by diminishing the need to receive them into or keep them in care or to bring them before a juvenile court. Local authorities are also empowered to make arrangements with voluntary organisations already engaged in such work. No powers are given under the Act, however, to intervene in family difficulties or in domestic problems unless there is a genuine risk of the children having to be received into care, or to impose guidance on parents unwilling to receive it. The statutory powers also enable steps to be taken to rehabilitate families whose children are already in care. A Home Office circular (No. 204/1963) sent to local authorities urged them to set up family advice centres, a method of approach to problems of family welfare pioneered at Manchester (Lingard, Platt and Oldham, 1961), and several authorities have already done so. Arrangements for giving help and advice may be made by local authorities with local Councils of Social Service; Family Service Units, which by their practical help to families assist to build up not only morale but some ability to manage their own affairs; National and Royal Scottish Societies for the Prevention of Cruelty to Children, both of which do valuable work in family welfare; Marriage Guidance Councils; branches of the Family Planning Association; Women's Voluntary Service which maintains clothing and furniture stores for cases of need; and moral welfare associations, to mention but a few of the voluntary organisations active in family welfare. For rehabilitation work arrangements may be made by local authorities with such residential units for mothers with young children as have been set up at Brentwood, Cheshire (1938); Mayflower Home, Plymouth (1948); Elizabeth Fry Home, York (1952); St. Mary's Mothercraft Centre, Dundee (1952); and at Crowley House, Birmingham (1956). Courses of training in mothercraft are also given at some women's prisons in both Scotland and England, especially for women convicted of child neglect.

Local authorities in their capacities as health, welfare, education and housing authorities already have considerable powers for assisting families generally, but the more specific preventive functions were laid on the shoulders of children committees of local authorities which must, therefore, through their children's officers, maintain close collaboration with these other departments as well as with voluntary bodies. The Children and Young Persons Act, 1963, does not prescribe any uniform arrangement for the co-ordination of preventive services. This is doubtless because of the fact that in 1950, a joint circular from the Home Office and Ministries of Education and Health was sent to local authorities, and a similar one from the Scottish Home and Health Department to Scottish authorities, recommending that they should appoint a designated officer in their area to co-ordinate local services, statutory and voluntary, concerned with family welfare. By 1963, all but ten local authorities in England and Wales had appointed designated officers responsible for devising arrangements to ensure full co-operation among all local services which could help in preventing the neglect of children in their own homes. All local authorities are urged to make as widely known as possible where advice and help may be sought by those with family difficulties.

Children in Care

Reasons for children coming into care. A local authority must receive into its care any child under seventeen years in its area if, in the opinion of the authority, such intervention is necessary in the interests of the child. Consequently, much social work is done by child care officers to attempt to mobilise family resources or enlist the help of other services of the local authority or of voluntary organisations as an alternative to taking a child into care. With the object of avoiding whenever possible the need for taking children into care when they are temporarily left alone as when both parents are in hospital, London County Council introduced in 1953, a 'child help' service. These 'child helps' work in the children's own homes, run the household and stay overnight. In spite of careful case-work and other measures, however, many children still come into the care of local authorities and voluntary organisations.

About half the children coming into care in any one year do so because of the illness or confinement of the mother. These children cannot strictly be regarded as deprived children since they remain firmly established members of the family and most soon return to the family circle. Then there are those deserted by the mother, and if no satisfactory alternative is possible they come into care, as also do many illegitimate children whose mothers are unable to make adequate provision for their care. A few children are orphans, others are the victims of parental inadequacy expressed as eviction, divorce, separation legally or by mutual consent, or the father and mother have just drifted apart, neither making any plans for the children. In some of these cases where the parent's whereabouts remain unknown for at least twelve months, or he has persistently failed without reasonable cause to discharge the duties of a parent, or he suffers from any mental disorder rendering him unfit to care for the child, the local authority may, by resolution, assume full parental rights. Parents or guardians may appeal against this to a juvenile court, or in Scotland to a sheriff. Ordinarily, however, when a child is in the care of a local authority, every endeavour must be made, consistent with the welfare of the child, to return him to his family, relatives or friends. If it is not possible for this to be done then the local authority must keep the child in care until he is eighteen years old, and may extend help to him until he is twenty-one years old, or longer if he is in receipt of education or training. A local authority is not, however, required to keep a child in its care if this is taken over by another local authority, or by the Minister of Pensions and National Insurance in the case of war orphans, or the child becomes subject to an approved school order.

Children may be committed by courts to local authorities under 'fit person' orders. Such children are those against whom offences such as neglect, abandonment, exposure, assault or ill-treatment have been perpetrated, or children who have fallen into bad company or been exposed to moral danger through lack of proper supervision. Some are committed when it is impracticable or undesirable for them to be entrusted to either husband or wife in proceedings involving spouses. A small number of delinquent children may be committed to care by courts, especially those who have not revealed any defects of character rendering it necessary for training at an approved school but for whom removal from home is required in the children's interests. These three groups of committed children remain in the care of local authorities until either the children reach eighteen years or the orders are revoked. A further group, and a small one, are those children who are taken into care on licence from an approved school because they have no homes or their homes are considered unsatisfactory by the managers of the school.

Number of children in care. The Home Office return for the year ending 31st March, 1963, revealed that there were 64,807 children, including 21,264 who were the subject of 'fit person' orders, in the care of local authorities. This was the highest number of children in care recorded since November 1953, when there were 65,309 in care. The age grouping of the children was: under two years, 5,026; two to five years, 8,265; of compulsory school age, 38,039; over compulsory school age, 13,477. The movement into and out of care was considerable, a trend which has been increasingly evident in recent years. Thus 48,479 children came into care and 47,319 returned to parents, guardians, relatives or friends. Confinement of mother, short- and long-term illness of parent or guardian accounted for 27,445 children coming into care, while 40,225 returned to parents, guardians, relatives or friends, 1,643 were adopted, 4,199 attained eighteen years, while a miscellaneous group of reasons accounted for the remainder passing out of care. A further 13,218 children were in the care of voluntary organisations, making a total of 78,025 children in the care of local authorities and voluntary organisations in England and Wales in March 1963.

In Scotland, for the year ending 30th November, 1963, there were 10,163 children in the care of local authorities, including 2,353 subject to 'fit person' orders. The age grouping was: under two years, 741; two to five years, 1,201; of compulsory school age, 5,941; over compulsory school age, 2,280. The total number of children in care has remained fairly constant over recent years but, as in England and Wales, movement into and out of care was considerable. Thus 6,645 came into care during the year and 6,494 were discharged from care, mostly to parents, guardians, relatives or friends. In addition, there were 1,835 children being looked after by voluntary organisations, making a total of children in care at the end of the year, 11,998.

Methods of Provision for Children in Care

Boarding-out. Under the Children Act, 1948, local authorities are required wherever possible to board-out children in their care. 'Boarding-out is a great deal more than the finding of a house in which a child may be given bed and board, kept reasonably clean, and sent regularly to school. It is, in its essential meaning, the creation of a home for the child' (Memorandum on Boarding-out, Scottish Home Department, 1959). A great deal of thought has been given by child care officers to the choice of foster-homes, for following the introduction of the Children Act, 1948, many unexpected failures in boarding-out placements occurred. It is important that not only should the family background of the child and the circumstances which necessitated his coming into care be taken into consideration, but the age of and attitude to fostering of the foster-parent. Trasler (1963) described in some detail the reasons for failures in the boarding-out system and suggested how these might be avoided. Three individuals at least are involved in boarding-out—the child, foster-parent and child care officer. The natural parents, too, must be considered, for in most instances their affection for their child is undiminished in spite of the circumstances necessitating their surrendering the child to the care of others, and they will continue to take the greatest interest in their child while he is with the foster-parent. It is only in exceptional cases that the natural parents will be precluded from keeping in touch with their child.

A recent development which has assumed considerable importance has been the greatly increased use of temporary or short-stay foster-homes. In some parts of the country this form of care has replaced the use of reception centres, residential nurseries and children's homes, for those children who are in care for only a short period, and much success has attended this approach to short-term care. Short-term fostering has also been used as a prelude to obtaining a more permanent foster-home for the child who is likely to be in care for a considerable period since it affords an opportunity of studying and assessing the child's requirements in a family setting rather than in the more artificial environment of a reception centre. In fact, some local authorities have abandoned the use of reception or assessment centres in favour of short-term preliminary fostering. The method also has the further advantage of enabling several children in a family being kept together and giving each other mutual support and contact after the separation from their natural parents.

The Boarding-out of Children Regulations (1955) and the Scottish Regulations (1959) govern all boarding-out by both local authorities and voluntary organisations, and include provisions to protect the child, ensure his supervision, and make proper medical and dental care and treatment available. While both Regulations differ in certain details, they require that a child be medically examined before boarding-out, within a month of placing in a foster-home, and at regular intervals thereafter, a written report being submitted on each examination by the doctor to the boarding-out body, whether local authority or voluntary organisation. Visitors appointed by the boarding-out body must visit each child regularly and submit a report after each visit on the child's welfare, health, conduct and progress. It is also customary but not obligatory for boarding-out bodies to notify the health department of the area in which a child is boarded-out, whether for short-term or long-term care, so that the local health visitor may undertake the general health supervision of the child.

In 1963, 52 per cent of children in the care of local authorities in England and Wales were boarded out but there were wide regional variations from over 80 per cent in some areas to under 40 per cent in others. In Scotland for the same year the national average was almost 60 per cent, a figure which has remained fairly constant over the years, the higher percentage being in keeping with the system of boarding-out practised under the old Scottish Poor Law. In both countries the number of children boarded-out by voluntary organisations is low, largely because voluntary bodies have specialised in residential homes for children. Boarding-out is not always the best method of care for every child. There are children with mental, physical or combined forms of handicap where, generally, boarding-out is ruled out, while there are others whose needs are best satisfied by a communal life in a children's home and who would not make the progress they do if they were members of a family group. It is therefore not to be expected that the proportion of children boarded-out in either England and Wales or Scotland will continue to rise indefinitely. To maintain existing levels of boarding-out local authorities must constantly attempt to attract new foster-parents and the Central Office of Information produces from time to time brief films and appeals for suitable people to offer their services as foster-parents. In 1962 the Central Office of Information was responsible for a film 'A Sense of Belonging' which gives a general picture of child care work, including the boarding-out aspect.

Residential homes. These still play an important part in the accommodation and care of deprived children. In 1963, there were 1,145 local authority children's homes in England and Wales, of which 809 were small family group homes. Disturbed and handicapped children for whom it is impracticable to make arrangements for boarding-out tend to be cared for in residential homes. In a report on the Role of Voluntary Homes (1960) by the Scottish Advisory Council on Child Care, attention was drawn to the substantial number of children in care who needed special supervision and treatment because of disturbed behaviour or handicap, and the hope was expressed that voluntary organisations, which generally have tended to concentrate on the provision of children's residential homes, might specialise in looking after such children. Indeed many voluntary organisations already undertake this special work. Broadly speaking, residential homes fall into fairly well-defined types, and an excellent description of the several varieties of residential home is given by Brill and Thomas (1964). The major types of home presently in use are reception centres, family group homes, grouped cottage homes, larger homes of the institutional type, residential nurseries and hostels. The conduct of all residential homes, local authority and voluntary, is governed by Regulations (1951, England and Wales, 1959, Scotland).

Reception centres. A report by the Homes Committee (1950) of the Scottish Advisory Council on Child Care, supplemented by a Scottish Home Department memorandum on children's homes (1959) both dealt with the provision of reception centres, especially for those children who are likely to be in care for long periods and where assessment of their needs could be made prior to boarding-out or other arrangements for their care. But not all children coming into care need be admitted to reception centres for, as already pointed out, short-term children may be placed directly with foster-parents and even those likely to be in care for long periods are probably often better assessed in a temporary foster-home than a reception centre. Consequently, reception centres are not considered by many local authorities as being essential components of their system of child care. Nevertheless, the centres prove useful for certain types of case, such as those children already in care but who for one reason or another must change their foster-homes and require reassessment before being suitably placed in others. Some reception centres are specially built for the purpose, most are adapted houses, *e.g.*, one of a group of cottage homes, a large house, or even part of a bigger children's home. The reception facilities accommodate between fifteen and thirty children of both sexes. Separate centres are required for boys thirteen to sixteen years and for adolescent girls unsuitable for admission to an ordinary reception centre for both sexes. At the centres the children receive any necessary medical or other attention. The centres should be pleasant and homely, staffed by persons experienced in the care of children who are told in language suitable for their age and mental condition about their situations and prospects as far as these can be known. Arrangements for the observation and assessment of children vary, but generally case conferences are held at intervals and attended by the medical officer, senior centre staff, children's officer or child care officer responsible for the particular child, with the psychiatrist and child guidance team as required. Outside social workers also concerned with the child may be invited to these conferences. While the stay of some children may be short, that of others who are unstable or disturbed may be for several months while treatment is being carried out before a final decision can be taken regarding their future care. Reception centres may be used as 'special reception centres' for the custody of children under fifteen who are on remand so as to avoid sending such youngsters to remand homes.

Family group homes. These homes may accommodate up to twelve children of both sexes, of ages ranging from two years upwards. The houses are usually ordinary houses in a street, and suitably adapted for their particular use and managed by a house-mother. The children attend local schools and participate in the activities of the community. Sometimes a married couple of suitable age and experience with children are in charge, the man going out to work and devoting some of his leisure time to the children. While there are certain inherent difficulties in the family group home situation, it can be accepted that if these are carefully avoided by good administration, such a home provides an excellent substitute for boarding-out. Arrangements must be made for necessary relief and domestic assistance for those in charge.

Grouped cottage homes. These consist of groups of cottages accommodating from ten to twenty children in each cottage, which is in charge of a housemother and assistants or a married couple. The whole group of cottages, which may accommodate from fifty to three hundred children of all ages, is under the supervision of a superintendent and his wife, who reside in a separate house in the grounds. The sexes are usually mixed in the cottages. One cottage may be set aside as a reception centre and another for sick children. Mostly the children attend local schools and nursery schools, but if these are provided within the group, sometimes also with playing field, swimming bath and similar amenities, the grouped cottage homes merely form segregated colonies of children too large to be absorbed readily into the life of the local community. It is difficult but important to try as much as possible to encourage the children to mix with other children in the community and usually this is attempted, but a tendency to some degree of regimentation is inevitable and it is likely that such children's homes will progressively disappear.

Larger homes. These single homes vary considerably in size but most have a maximal capacity of about fifty children, generally of school age, and of both sexes, though some are restricted to one sex. Such large homes have come in for much adverse criticism, some of it quite unjustifiable, their critics often seeming to regard the homes in terms of 'Oliver Twist', doubtless because they were first built under the Poor Law and by voluntary bodies during the second half of the nineteenth century. It should be borne in mind that there are many children whose needs are best satisfied by a communal life and who would not make the progress they do if they were members of a small group. The children in these larger homes are allowed to mix freely among themselves but are divided up into family groups of some six to twelve, each in charge of a house-mother who makes them her special responsibility, gathering them together at meals which she herself takes with them, and at other times for stories, games, and at bedtime. Large dormitories may be partitioned off for these groups, or even each bed partitioned off, so as to give each child the feeling of having a room of his own in which he has a personal locker where he keeps his treasures. The house-mother sleeps in her own room near the group. Accommodation is required for home-work and other pursuits of the children. Space for indoor and outdoor play, with sufficient equipment, must be made available. Contact with the outside world is as essential in this form of children's home as in the grouped cottage homes. The larger homes are vulnerable to the spread of infectious disease and prompt action must be taken when cases occur.

Residential nurseries. The growing trend against the use of residential homes for infants and young children has resulted in less use being made of residential nurseries for the long term care of these young children, though some need nursery care. The tendency is to use the nurseries rather as reception centres for children under five years. Some of these nurseries were built for the purpose, others were adapted large houses. Save for the infants under one year, who generally form a separate unit with their own staff, it is accepted that the other children should mix with each other and develop a close relationship with one or two members of the staff,. The children may live in groups of five or six, each group in charge of a trained nursery nurse helped by a relief member of staff who may share her time with two groups. The essential principle in any nursery, large or small, is that each child should have continuity of care from at most two members of staff. Consequently, the staff–child ratio must be high, at least 1:2 for infants under eighteen months and 1:2½ for those older. The need for day and night attention, the risk of infection, and the task of ensuring the individual development of each child are problems mainly to be met. A Home Office memorandum on the Needs of Young Children in Care (1964) offers much valuable advice on the care of this group.

No unaccompanied child under three years may be accommodated in residential nurseries associated with National Assistance institutions save with the consent of the Secretary of State or the Secretary of State for Scotland, and their consent is also required for the accommodation of similarly unaccompanied children over three in these nurseries if the period of their stay exceeds fourteen days.

Hostels. Every local authority and voluntary organisation must do what it can to find suitable accommodation, either in hostels or lodgings, for young people over compulsory school age and under twenty-one who have been accommodated in children's homes or were boarded-out and are now employed or undergoing training. Some hostels are run by local authorities, others by voluntary organisations. These vary in character and administration and provide for boys and girls but not both together. The youngsters may be left to their own devices during their leisure time but more often a warden or matron possessed of some understanding of the needs of adolescents is employed to help to provide a more homely atmosphere, assist with social and recreational activities, and care for the moral welfare of the inmates.

Voluntary organisations play a notable part in making provision for training homes to which boys and girls over school-leaving age and who are in need of character training are admitted. Instruction is given in such occupations as farming, carpentry, laundry and domestic work, and both long- and short-term trainees are accepted.

Holiday arrangements. The need for holidays for children in their care is recognised by both local authorities and voluntary organisations and arrangements of varied character are made for annual holidays of a week or fortnight's duration to be afforded children who are boarded-out or in children's homes.

Social activities. Social and recreational activities are essential in all children's homes, and encouragement should be given to the children to join outside youth organisations of their own choice. Suitable books, magazines and papers should be provided. Voluntary agencies and private individuals contribute greatly to the welfare of children in homes and undertake a variety of personal services. These include invitations to individual children to visit private houses, a development of which often leads to 'uncle and aunt' schemes; entertainments and instructional visits, *e.g.* cinemas, local factories; birthday and Christmas cards and presents; help inside the homes by organising leisure activities; repairs to and making of toys. Visits from parents, relatives and friends should be encouraged although discretion must be exercised to prevent undesirable persons from visiting. So long as parents have affection and sense of parental responsibility, the staffs of children's homes can, by perseverance and understanding contribute greatly to changing or restraining them and so making it possible to re-establish some children with their parents (Lewis).

Medical arrangements. Arrangements must be made for the appointment of a doctor for each local authority and voluntary children's home. His duties include not only medical care and treatment, but regular attendance at the home, carrying out the periodic routine examination of the children, giving prophylactic inoculations, keeping the medical records, and generally supervising the health of the children and hygiene of the home. It may be that arrangements are made with a local practitioner to carry out the treatment of any sick child under the N.H.S., while a medical officer of the local health authority undertakes the routine medical supervision and care. The advice of the medical officer of health is required in matters relating to infectious disease and generally he concerns himself with all factors relating to the health of the children and staff. He will also be involved in the supervision and training of mentally handicapped children both when in children's homes and when they leave school. The health of the staff, too, is important, and they should be medically examined before appointment, with an annual chest X-ray thereafter.

Fire precautions. These are important in children's homes and the local fire service officer should be consulted, not only on the precautions which must be taken in the way of fire-escapes and fire-fighting equipment but also in conducting fire drills.

After-care. Local authorities and voluntary organisations alike recognise the need for after-care, and both make provisions for it, in their schemes, which include financial help in certain circumstances. Full use should be made of the youth employment service, and the children's officer or the representative of the voluntary organisation should continue to advise and guide the young people after leaving the foster-parent or children's home.

Child Protection

Some parents such as those going abroad, unmarried mothers and widows who have to work to maintain themselves and their children, and widowers who are unable to care for their own children, make private arrangements for the care of the children by placing them with friends, neighbours or strangers and make direct payments to these individuals for looking after the children. Any person, other than a relative, who agrees to undertake for reward the care and maintenance of a child under school leaving age for a period longer than a month must notify this fact to the local authority at least a fortnight before receiving the child or, if in an emergency, within a week of receiving him. The children's officer will then arrange for the home to be visited, and if it and the proposed foster-parent are suitable, will sanction the arrangement under the provisions of the Children Act, 1958. A child so placed is called a 'foster-child' and the local authority must have him visited from time to time and the foster-parent advised regarding the child's well-being as necessary. In England and Wales in 1963 there were 8,038 foster-children under supervision of local authorities, and 336 in Scotland.

Local authorities are also responsible for the supervision of 'protected children' as defined in the Adoption Act, 1958. This supervision continues until either an adoption order is made or the child attains the age of eighteen. Some children, especially illegitimates, are handed over at or soon after birth by their mothers to foster-parents without payment. If these foster-parents make no subsequent application for adoption, no supervision is undertaken. Similarly, children entrusted to relatives, whether for reward or not, are not supervised by the local authority, though the conditions under which they may be cared for are unsatisfactory.

Adoption

Arrangements governing adoption have developed considerably since the first Adoption Act, 1926, and adoption has now become an important feature of social life in Great Britain. The object of adoption has been described as 'to make nobody's child somebody's child'. Sometimes parentless children boarded-out by local authorities are adopted by their foster-parents, but of course not all deprived children are available for adoption. Most have parents to whom, sooner or later, it is hoped they will return when the circumstances leading to the break-up of the family's life have been overcome. The number of children for adoption, therefore, is limited and most come from the ranks of the illegitimate, especially during the first year of life. With increasing interest being shown in the medical problems associated with adoption a medical group was formed within the framework of the Standing Conference of Societies Registered for Adoption in 1963. While membership of this group is restricted to medical advisors of registered adoption societies, medical officers who advise children's departments of local authorities on adoption matters are encouraged to participate in the group's discussions without being members of the group itself.

The present legal system of the country permits of four ways of placing a child for adoption:

1. Through the mother or legal guardian;
2. Through a third party, *e.g.* lawyer, doctor, private individual;
3. Through a registered adoption society;
4. Through the children's department of a local authority.

Generally speaking the first method is a poor one, as often the placing of the child is done hurriedly and without great consideration, the mother knows the adopters, and they lay themselves open to disappointment. Some of these adoptions are, however, very successful. When the prospective adopters intimate to the local authority their intention to adopt the child and so commence the necessary three months' probation period, help may be given by the authority, but it cannot take the place of careful initial assessment of child and adopters before placing. The second method in the hands of inexperienced but well-meaning individuals is also open to the criticism of unselected placing, but if it is carried out with care and understanding it can be a very successful method. The Hurst Committee (1954) did not consider it wise or practicable to prohibit either direct or third party placings but recommended that third parties should be served with notice of the application to adopt and be interviewed by the guardian *ad litem*, a recommendation incorporated in modern adoption practice.

The best methods are through the agency of either a registered adoption society or local authority. Adoption societies, of which there are between seventy and eighty in Great Britain, are all voluntary organisations and require to be registered with the local authority. They are not permitted to charge for their services but may accept donations to their funds from adopters and others. Many have experienced social workers on their staffs, who give expert and sympathetic guidance and help both to natural parents and prospective adopters, and societies generally take considerable pains over placings. Children's departments of local authorities are entitled to make and participate in adoption arrangements whether or not the children concerned are in care. They, too, take great care in placing children.

The practical considerations of adoption can conveniently be discussed under three headings—the mother, the child, and the adopters. Reasonably satisfactory legislation is not in itself a sufficient safeguard unless it is backed up by an intelligent and sympathetic administration.

The mother. The mother is usually, but not always, the mother of an illegitimate child. She must, on application to the adoption society or local authority, be seen by an experienced social worker and her problem fully discussed with her. She must be protected from hurried or panic decisions. Her reasons for wishing to have her child adopted should be ascertained and every effort made to help her to keep her child if her future prospects seem at all reasonable and suitable arrangements can be made for the care of the child until the mother is in a position to undertake it herself. The attitude to the mother must be kindly and helpful, otherwise she may be tempted to place the child herself.

The social worker interviewing the mother must assure herself that the mother appreciates the full implications of adoption—that the separation of mother and child following his adoption is final and complete. When a child is to be placed at the disposal of an adoption society or local authority the mother is furnished with a memorandum couched in simple terms explaining the effects of an adoption order. Attached to this memorandum is a certificate which the mother signs indicating that she understood the contents of the memorandum, and this is returned to the society or authority. After the child has been placed, and always when he is over the age of six weeks, the mother is asked to complete and sign a witnessed form of consent, the witness assuring himself that the mother again understands the full implications of adoption. This consent requires to be produced in court as evidence. The mother may specify the religion in which she desires the child to be brought up. As a final stage the mother is informed by the court before it hears an application for the adoption of her child and she then may with the court's agreement withdraw her consent.

Medically, a careful history of the mother, and father if known, is essential, with especial reference to hereditary disease. A suspicious history demands careful consideration of her application. A complete medical examination of the mother is desirable, but not legally necessary, and this, including blood serological tests for syphilis and a chest X-ray, may be carried out in the ante-natal period or at the time of application if this is subsequent to the infant's birth.

The child. The child must be at least six weeks old before the mother can give her formal consent to his adoption and the minimum probationary period of three months only starts after this age. Consequently, it is the practice with some adoption societies and local authorities not to place a child with prospective adopters before this age, but this is not necessary. A child may be placed before he is six weeks old if the adopters are willing to accept the risk of the mother refusing her formal consent and demanding the return of her infant. The question of the age at which a child should be placed is one of some controversy. One group of workers argues that the mother is too little considered in adoption work and that the six weeks' period when she cannot give consent is too short, that early placing means the denial of the accepted benefits of breast feeding, that the mother's moral behaviour is strengthened when she retains her child for a period, and that, at least in some instances, she can more readily surrender her baby if given more time. The other group holds that early placing can be facilitated by careful case-work with the mother ante-natally, that early placing makes possible the continuity of welcoming care for the baby and spares the mother the greater distress of parting with him when she has become fond of him, that some mothers prefer to part with their babies without seeing them, or at least soon after birth. Each case must be considered on its merits. Twins should always be placed together.

Before either a society or authority place a child he must be medically examined and a report in prescribed form submitted to them. This report is identical with that required to be submitted later to the court when application to adopt is made. This pre-placing report raises certain difficulties. Most adopters ask that the child whom they adopt will be physically and mentally sound. Further, a serological test for syphilis is required after the infant is six weeks old. The certificate may be completed before this time after careful examination of the child who may then be placed, the serological test being carried out later when the child becomes six weeks old. The responsibility for ensuring that the test is done and a report thereon obtained from the doctor rests with the society or authority concerned. The examination should be carried out with the mother present but if this is impossible she should be seen at another time and a full history obtained. Much of the obstetric history may, however, be best sought from the doctor or hospital concerned with the confinement.

Because of the views held on too early placing, the inability to obtain the mother's formal consent, and the need for the serological test after the infant is six weeks old some societies and authorities favour intermediate placing with a carefully selected foster-mother or in a baby home until the required medical certificate can be satisfactorily completed and the child placed with adopters. These baby homes must be small with a high staff–child ratio (1:2) so that each child may receive individual mothering.

Before application can be made to a court for an adoption order a further medical certificate must be obtained and submitted along with the application form, child's birth certificate, mother's signed and attested form of consent, and medical certificate of the adopter's health. In direct and third party placings only one medical certificate is required, which must accompany the application to adopt. Some doctors believe that all examinations of children prior to placing and to application to adopt should be carried out by a paediatrician but the Act does not require this. If anything abnormal is found in the child it is the examining doctor's duty to inform the prospective adopters of the abnormality but he is not required to express an opinion as to whether or not a child is fit for adoption.

The doctor's interest in a child does not cease after the child has entered the adopter's household, and by his advice and guidance he can give much help and support since the adoption situation is new both to adopters and child. A point of practical importance is that the child should, from an early age, be aware that he has been adopted, the word 'adopted' being used easily and with pride by the adoptive parents. The true situation will thus gradually be revealed to the child as he advances in age.

The adopters. Prospective adopters, on application to a society or local authority, are interviewed and full reasons obtained for their wish to adopt a child. In many cases their childless state is due to medical or surgical causes. The sole reason for wishing to adopt is love of children. This is fundamental. The greatest care must be taken that the proposed adoption is not being tried as a last desperate remedy for neurotic wives or in an effort to patch up a disintegrating marriage in the hope that the child will remedy a deeper defect. Steps must be taken to ensure that the adopters appreciate their obligations and duties to the child, including a reasonable assurance of economic stability and social responsibility, while their age should conform as closely as possible to what would probably be the natural age of parents for the child. References from responsible persons will be required, while the adopter's home will be inspected by or on behalf of the society or authority, and enquiry made as to whether it would be detrimental to the child to be placed with the applicants. In addition, the society will, before accepting adopters, require a somewhat detailed medical report in respect of each of them, and this report is submitted by the applicants' doctor after obtaining their permission to do so. There is, also, a legal obligation on all adopters no matter by what method they obtained a child, to submit to the court a medical certificate on a prescribed form that each is 'physically, mentally and emotionally suitable to adopt a child', the certificate in Scotland being certified 'on soul and conscience'.

Some Special Adoption Problems

Adopting the older child. The older child, possibly illegitimate or orphaned, may be adopted by relatives or friends without any difficulties arising for either child or adopters. With the older child, however, who may be adopted by persons unknown and unrelated to him, the placing is not an easy one. He may have memories of his own parents and his home which constituted his former world and he may be difficult for a time because he reacts against the new environment and finds it hard to fit into it. Consequently, the child should be carefully placed with prospective adopters who act in the first instance as foster-parents so that adequate relationships may be established, leading in time to his adoption by them. For the child in a residential home, encouragement should be given to suitable prospective adopters to take the child initially for short outings to their home, increasing these outings in frequency and duration until in time the child might be taken for a holiday or for a period of stay in their home for a length of time long enough to get beyond the 'best-behaviour' stage on both sides, as a prelude to the final stage. Individuals who take older children require to be mature and well-balanced, and those who are most successful in their adoptions are those with a strong natural aptitude for loving the lonely child. As in all other adoptions, medical certificates in respect of both child and adopters are required and the child's wishes must be consulted if he is of such an age. In Scotland formal consent to his adoption must be obtained if the child is over fourteen years, or twelve years in the case of a girl.

Adopting the difficult child. Difficult children include those with suspicious or definite parental histories of hereditary disease or mental disorders, those born of an incestuous union or mixed parentage, those who are physically or mentally handicapped, and those in whom, especially among older children, various factors have produced maladjustment. A doctor examining such a child for adoption is bound to report the defects he finds and provided that the adopters know all that can be told them about the handicap of the child for whom they may wish to assume responsibility and they appreciate the difficulties which may arise, there should be no discouragement to the adoption. But there are few adopting parents who are willing and endowed with a quality of parental feeling which fits them for the care of a child with an acknowledged handicap.

The legitimate child. Recent press reports have given publicity to legitimate children being offered for adoption. Broadly speaking, parents of such children are widows or women unable to undertake the responsibility for a child without the husband's help and support, parents living in poor home conditions or with financial difficulties and who wish to have a fourth or fifth child adopted, young women, pregnant before marriage and compelled to marry the father, young married students. Sometimes these applications are made to adoption societies or local authorities before the infants are born, but in general there is a natural reluctance to accept these cases.

The coloured child and child of mixed race. It may be natural that in this country there is some reluctance to adopt coloured children or children of mixed race, but a small proportion of prospective adopters are prepared and willing to do so. Sometimes such children are placed by adoption societies and local authorities for straight adoption, at other times a trial period of boarding-out is felt desirable before a decision is reached regarding application to adopt.

Research

The Children and Young Persons Act, 1963, empowers the Secretary of State and the Secretary of State for Scotland through the Home Office and Scottish Education Department respectively to conduct, or assist others in conducting, research relating to the promotion of the welfare of children, the care of children by local authorities and voluntary organisations, and the adoption of children. The Act confers similar powers on local authorities.

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Chapter 15

CHILD GUIDANCE

Both the title and the money to start in England what are known as Child Guidance Clinics, planned to deal with the maladjustments of childhood, came from the United States of America. This impetus arose long before the second world war, or 'lease-lend', were ever thought of, and it is easy to forget how much this country owes to her generous neighbour, for here was a gift made by the Commonwealth Fund of America which carried no conditions other than the natural and happy consequence of many exchanges of personnel. The first workers in the United Kingdom were trained as guests of the Fund at the New York Child Guidance Clinic in 1928, and financial support for the movement in this country was not wholly withdrawn until 1948 when many clinics were well under way.

However, before the child guidance movement became organised in this way several clinics and hospitals, notably the Tavistock Clinic and the Maudsley Hospital, had facilities for treating children, and Dr. Hector Cameron's pioneer work for nervous children, in the children's department of Guy's Hospital, left no doubt in the minds of paediatricians that many physical symptoms sprang from a nervous or neurotic origin, and were better treated if this were appreciated. Following the first world war, the impact of Freud's teaching in this country illuminated much that had previously been obscure in the origin of neuroses, and his theories led to an understanding of the nature of childhood neurosis. While these theories were debated and hotly criticised, and less freely accepted here than in the U.S.A., it was no longer possible to hold the view that neurotic symptom-formation was something which bore no relation to normal function. Perhaps in the last ten years the pendulum has swung dangerously far in the opposite direction, so that much stress and conflict is regarded as a symptom of neurosis rather than as the inevitable accompaniment of human development. True, the parents of today have to help children in their difficult adjustment to the pace of modern life, and they learn, as parents always have done, to buffer much of the conflict. It is important that we, as doctors, should help them in this task, guiding and participating rather than sitting back and giving didactic advice.

All forms of therapy which try to correct maladjustment in the emotional sphere require such an understanding of the patient that treatment becomes far more of a participation by the therapist in the problems involved, than is the case in physical medicine, and it is common therefore to speak of the therapeutic relationship. Much of the training of psychiatric workers in all spheres, not only in the medical field, involves an understanding of how to manage this relationship so that it becomes something on which the patient does not only lean for support, but which involves him in an act of singular honesty and trust in his therapist, to whom will be assigned many roles in the patient's fantasy. In this way, traumatic situations can be re-experienced in a safer setting, and accepted in a more mature way. It will readily be appreciated that work of this kind takes time, and that not everyone wanting to do it proves capable of being trained in the art and the restraint necessary to undertake such work. Hence, it is usually found that child guidance clinics are understaffed, have waiting lists, and that there is an overall shortage of professionally equipped people to staff them.

The term 'team approach' is often used in talking of child guidance work, for the reason that the complete team of staff for such a clinic comprises several professional disciplines. In so far as much of the work is psychiatric and diagnostic, the medical member of the team is a psychiatrist who, in addition to his training in general (adult) psychiatry, will have had special experience in the psychological disorders of childhood. He may himself have come into this work from a paediatric training or he may have a paediatrician to consult with in considering the psychosomatic aspects of his work. It is important that every child sent for psychological help should have a physical examination from a paediatrician (who may act in association with the school medical service) if his needs are to be fully served.

There may also be a non-medical therapist attached to the clinic and working under the general direction of the psychiatrist, who is thus set free from diagnostic work in order to undertake some of the detailed therapy which is likely to be on analytical and interpretive lines, using the child's play and free expression of fantasy as the case material, analogous to the spoken material provided by the free associations of the adult psychiatric interview.

The psychiatric social worker undertakes work with the parents often at the clinic and less often in the child's own home, and while her therapeutic relationship with the parent may partake of the intimate quality described above, she may also have to manipulate skilfully her less deep contacts with the referring agency, or the probation officer, and indeed any other people who may confer with her on the case.

So far as the school and the teachers are concerned, it is likely that the educational psychologist will be mainly responsible for making and continuing the contact, since his work lies in understanding and testing the child's native ability, and seeing where his emotional problem is cutting across his adjustment within the school. Educational psychologists are selected from those who have had experience and training in the educational field, and it is often an additional part of the psychologist's duties to act as adviser to the education authority in regard to all their handicapped children.

These areas of work overlap, and of course converge, in any one individual child when he becomes a 'case'. Not all children referred by a teacher as problems in the class-room will necessarily be referred by an educational psychologist to a child guidance clinic; some he may deal with in his own professional competence by an adjustment in classwork. It is unlikely, however, that a child referred to a clinic for full service will not also have a careful test of his intelligence, since this is as much a part of estimating the nature of his difficulty as is a retinoscopy in deciding whether a child needs glasses, or a urine test in an enuretic. Therefore the conference, when these different workers pool their findings, is an important part of child guidance clinic work. It serves to bring a widely varied approach to bear on the whole child and his problems, and the simple removal of symptoms is no longer regarded as the ultimate therapeutic aim. Rather the symptom is seen as truly a maladjustment, but nevertheless one having a dynamic value to the patient, which he uses in dealing with conflict, and which he cannot afford to drop, unless the conflict itself is radically dealt with at a deeper level.

A further use for the conference is in teaching and training. The psychiatric interview, whether based on play or on exchange of talk, can never take place quite unreservedly in the presence of a third person, and the ethics of concealing an observer, whose presence is unknown to the patient, is often in doubt, and may well hinder the therapist. Therefore, this work is difficult to teach by any form of apprenticeship and direct observation of work in process. More often, after a period of theoretical training, the worker is given a case to handle under supervision, so that his material may be discussed in open conference, although his technique will be a matter of individual tutoring by whoever is controlling his training. An outside worker, for example a probation officer or teacher in a school for maladjusted, may be invited to participate in such a conference, not only so that the pearls of wisdom may be shared, but also in order to link theory with practice and to ensure that any plan for treatment is undertaken with all the knowledge of the situation available and shared by those whose job it will be to steer it. This may seem a cumbersome, time-consuming and unnecessarily detailed approach; but in time spent it contrasts quite economically with the enuretic who has attended monthly for a year or more without improvement, or the ten-year-old who sits uncomprehending in the back row of a class, still unable to read, and making his presence and boredom felt in undesirable ways.

Since child guidance clinics will in the main deal with the problems of children who are attending school, it has been the practice of a number of local education authorities to set up such units, either independently or as part of the school medical service, in the sense of sharing existing premises. With the coming of the National Health Service, these existing clinics have continued with, in the majority of cases, the medical staff coming from the regional board, while the lay staff, psychologist, social worker, speech therapist, remain as employed by the education authority. In some places, however, the regional boards have set up clinics as part of existing hospital out-patient departments or staffed by personnel from the local mental hospital. In the survey of mental health services made in 1946 by Blacker, he differentiated the clinic within the educational service as a child guidance centre, and reserved the term Child Psychiatric Clinics for services run exclusively by the regional hospital board, as, for example, a fully staffed clinic forming part of the out-patient department of a paediatric or general hospital.

Arising from this distinction in administration and nomenclature, it was supposed that the more serious case and any long-term therapy would be undertaken at the hospital clinic, while the educationally orientated centre would deal with the less severe case, and with those children whose problem lay in the educational sphere. This has proved an altogether too tidy and finite view, if only because children's problems do not tend to be limited to any particular operative field, whether light or severe and, because of their longer experience and establishment, many of the educational centres had better staffs than the National Health Service clinics (and to the ancillary staff they offer better pay) and they had also established local reputations and local liaisons, for example with the juvenile courts. Thus, in operation both clinics and centres seek to cover the same sort of ground and get as good a staff as they can to do the work. Shortages remain, and therefore so do waiting lists.

Since the 1944 Education Act, it has been obligatory for the education authority to recognise the maladjusted as a category of handicapped pupil, and to provide for his care and education as is required, and this has led, among other statutory provisions, to the recognition of a number of schools, as suited for the education, away from home, of maladjusted children. While some of these residential schools have run for many years, giving particular help to those children whose homes have given them little or none, others have developed out of war-time arrangements improvised to deal with evacuated children. The education authorities are also responsible for a number of hostels where children who are found to be in need of this particular kind of help, can live, away from home, but in a small group probably attending the local day-school. The latest returns indicate that just over 4,000 maladjusted children* are receiving help by means of residential treatment in a school or hostel.

Finally, it has been found that a small number of children show such a severe degree of disturbance that only mental hospital care is suitable. These are the psychotics, and those who from an early age have shown grossly deviant development which yet remains distinctively different from that of the emotionally unstable mental defective. There are now (1964) twenty-one small units, with an additional seven accepting only adolescents, which are run in conjunction with hospitals, either hospitals for the mentally ill or borderline adults or mentally subnormal patients, or linked with a paediatric unit. These special units are however individually run, and usually geographically separate from the 'parent' unit. The pre-pubertal child, however disturbed, is not well served by the ordinary run of mental hospital adult ward.

These varying forms of care can now be summarised. A parent, family doctor or teacher, recognising a behaviour problem which requires treatment will refer the child with his parents to the appropriate clinic or centre. This may be an outpatient clinic at the local general or paediatric hospital, or a service run from a neurosis centre or mental hospital. Or it may be a child guidance centre run by the local education authority and closely linked with the school health services. In all but a few cases the child and his parents will be seen a number of times as outpatients although here and there inpatient hospital observation facilities exist. His treatment may cover a long period of time, but during it he will continue his usual activities at school, at home and with his friends, and his adaptation to this ordinary life will afford a valuable gauge as to his progress.

In the few cases where it appears that only removal from home will allow of a complete adjustment, residential care in a specially chosen school or hostel may be recommended. While financial responsibility will be undertaken by the local education authority for such a recommended removal from home, there is no statutory power to insist on it other than by recourse to the juvenile court for an order. This distinction is an important one, since for the delinquent child, removal from home may reflect a degree of social failure and certainly failure to co-operate, while, with the maladjusted child, it remains a medical recommendation to which the parents agree. Only in the event of the parents of a maladjusted child frivolously or maliciously refusing to co-operate would it be likely that a court order would be sought to enforce it. Were such a course necessary, then the local authority would in all probability be asked to assume guardianship of the child under a 'Fit Person' Order, so that proper care and treatment could be carried out. This procedure would have to go through the juvenile court and become a judicial order enforcing a medical recommendation, which would, if agreed to, be carried out by the local education authority.

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* This figure does not include children who are placed away from home either as delinquents or in need of care, by the juvenile courts and under the supervision of the Home Office.

But by far the greater number of child guidance cases remain as outpatients. Co-operation by the parents, and their participation in every stage of treatment is an integral part of it. So is the adjustment, often necessary, in the school programme. Here the help of an educational psychologist closely linked with the schools may prove invaluable. Indeed in one Scottish city, help for maladjusted children is given almost entirely by and through the psychologists and the schools and day-classes organised to deal with these problems. It is obvious that no child who is sufficiently troubled to need a clinic will be likely to adapt wholly successfully within school. A very high proportion of maladjusted children appear to be dull, when in fact they are educationally retarded and in dire need of individual help in school with their learning. It is sometimes difficult to distinguish cause and effect, since a high degree of failure in school is likely, by itself, to cause some degree of maladjustment. The development, particularly in London, of day special classes for these children has shown how often they can respond to an informal approach in a small group where confidence and interest in work can be restored. As is usually the case in all adjustment work, the personality of the teacher undertaking such classes is of more importance than any specific methods.

Finally, mention should be made of one form of consultant service to mothers and children which is still a relatively new development. In the antenatal clinics, and in lying-in wards, there is a unique opportunity to study the attitude of the younger mother to her approaching confinement. She may prove to be very anxious for help in making a new adjustment. All her care in feeding, bathing and changing the baby may be approached with a lack of confidence, while perhaps realising that much later trouble stems from the success or failure of this earliest relationship. Later when she attends the maternity and child welfare clinic, she may want help and advice in dealing with an infant who finds difficulty in settling down to an easy routine. Telling a young mother how to feed or how to hold a baby may be of no avail when her difficulty relates to some failure in her own nature (Soddy, 1960). A psychiatric consultation, with further help available from a psychiatric social worker, at this stage, may go a long way to helping the mother towards maturity and confidence, and may prevent a state of tension developing. Some of the later problems of feeding and of habit-training can indeed precipitate quite severely negative reactions between parents and children, and advice comes, if available, just when a mother feels she needs it. It may even be that greater security in regard to physical care of illness in infancy has led to a certain loss to the child of tenderness and warmth which he needs quite as much for its emotional as for its physical value. Clinics based especially in paediatric hospitals have a high proportion of cases referred in the pre-school years, and these cases would be missed in a service catering only for children of school age.

Since child guidance clinics deal with situations and symptoms rather than with diseases, there is no very satisfactory classification of the conditions likely to need this type of investigation and care. The following, based on a classification adopted by the Child Guidance Council, and formerly used by many clinics, serves to give some idea of the problems likely to be sent for advice and treatment to a child guidance clinic.

NERVOUS DISORDERS

Fears—anxiety, phobias, timidity, over-sensitivity.
Seclusiveness—unsociability, solitariness.
Depression—brooding, melancholy periods.
Excitability—over-activity.
Apathy—lethargy, unresponsiveness, no interests.
Obsessions—rituals and compulsions.

HABIT DISORDERS

Speech—stammering, speech defects, aphonia.
Sleep—night terrors, sleep-walking or talking.
Movement—twitching, tics, head banging, nail biting.
Feeding—food fads, nervous vomiting, putting things into the mouth.
Excretory—enuresis, faecal incontinence.
Nervous Pains and Paralysis—headaches, deafness, etc.
Fits—epilepsy, hysterical fits, loss of memory.
Physical—allergic disorders, asthma.

BEHAVIOUR DISORDERS

Unmanageable—defiance, disobedience, refusal to go to work or school.
Temper.
Aggressiveness—bullying, destructiveness, cruelty.
Jealous behaviour.
Demanding attention.
Stealing—begging.
Lying and romancing.
Truancy—wandering, staying out late.
Sex difficulties—masturbation, sex play, homosexuality.

PSYCHOTIC BEHAVIOUR

Hallucinations, delusions, extreme withdrawal, bizarre symptoms, violence.

EDUCATIONAL AND VOCATIONAL DIFFICULTIES

Backwardness—mental retardation, school failure.
Inability to concentrate—day-dreaming, inattention.
Inability to keep jobs.
Speech disabilities—high frequency deafness, etc.

FOR SPECIAL EXAMINATION

Psychological examinations.
Educational advice.
Vocational advice.
Court examinations.
Admission to special homes or hostels.
Placement in foster-homes.
Adoption.

Such a grouping at least makes it possible for one area to compare problems of incidence with another area, but often many problems co-exist in the same child, and clinics are increasingly tending to adopt their own systems of diagnostic classification. No system of classification is likely to fit every point of view; for instance many would feel sure that an item such as 'refusal to go to school' must be broken down into the episodic truant, the child with learning difficulty, and the more severely neurotic cases of school phobia (see Kahn, 1964).

In view of the close relationship between stages of development, and the emergence of emotional stress, so clearly shown in Chapter 9, it may provide a picture more realistic from the paediatric angle, if problems are considered in relation to the age at which they most commonly arise.

Infancy. Good, loving care and confident handling are essential if both parents and child are to grow together and learn from one another. From this indispensable relationship springs the child's capacity to love, because he has himself been nurtured in love, which in turn has sprung from the love of his parents one for the other. The human young do not die nowadays when they are neglected, or indifferently cared for. The antibiotics and the many ramifications of the welfare state see to that. But the child of a broken home, or a loveless marriage, even of an immature mother and father, grows up in an atmosphere of emotional poverty or tension which is likely to restrict his own natural development. He may become an anxious and forever seeking person who has not experienced abundance in safety, or he may become indifferent and what Bowlby (1951) has aptly called 'the affectionless' child. If he fails to respond he may go further and express hostility and cruelty in relation to those about him. It will be difficult for him to accept discipline as something worth having, and not as something imposed which he can only resent and resist. There is now abundant evidence that the closeness and warmth of physical affection helps the normal tie of mother to child and that breast feeding is the natural expression of its closeness. The great fetish of early regulation of the infant, the value of controlled formulae in feeding, and leaving a child to 'scream it out' if he has a tantrum or a night terror, all impose an unnatural restriction on mothers. Fortunately, even when prescribed, many mothers had the sense not to become a slave to medical fads. It is easy enough however, to veer in the opposite direction, so that every mother who has a difficult child comes to feel that she must at all costs give way to his demands lest she distort his personality. This is, of course, only likely to happen to mothers who need to be correct rather than natural, and who from their own insecurity prefer to 'go by the book' rather than develop their own techniques. Fortunately, most parents do love their children, and making mistakes will not be too deeply regretted, but will be accepted as natural in any process so varied as normal human development.

Nevertheless, advice during infancy may do much to help this very needful mother-child relationship to become safely established.

Pre-school child. That it should do so is clearly important for the next stage. If, in infancy, the problems are likely to be in the sphere of relationships, in the toddler stage they will appear as management problems. But the art of managing this difficult period in early childhood will obviously depend on the quality of the fundamental early relationships; if these are firmly established, then they will survive the battles encountered here.

These conflicts can be ranged around three major adjustments which the normally developing child is likely to meet. First, he must not only be actually weaned, but emotionally he must achieve a measure of independence, finding himself as an individual, and forging new links with his father and his mother in so doing. Secondly, as an individual, he adventures into a more or less dangerous and delightful world. Every step he takes may give him new confidence, yet may take him nearer the ordinary dangers of fire and water from which he will be lovingly (and not frantically) shielded. Thirdly, he may well have to accept and understand the coming of a new baby to succeed him, besides enlarging his social world to include other adults and other children who will claim his attention and perhaps come between him and his immediate source of security. Threaded through these basic patterns of growth is the enormously swift upsurge of new skills, each bringing with it fresh demands. 'Say please'—'mind the door'—'give it to Johnny'—'eat it up'—'go to sleep like a good boy'. A most confusing medley of injunctions will greet him, not to mention the complications which his own inexperience brings to him. One has only to watch the alarm and discomfort of such a child when something he does or says is greeted by a shout of laughter to realise what is meant by the hard-worked term 'over-sensitive'. Reference to the above table will quickly show what a multiplicity of symptoms belong to this age.

This concept may help to explain why a separation from home and parents may have such a devastating effect, since that normal source of security and shelter is sought many times a day. The most dangerous effect of separation is a kind of freezing of emotional response, and a blunting, which may be permanent, of that sensitivity which, like the antennae of an insect, serve to guide the toddler in his explorations.

The schoolchild, who has come through this stormy passage without undue setbacks has some measure of confidence in himself, and is ready to go ahead to a more deliberately fostered phase of learning and intellectual stimulation. The age of school entry being earlier in this country than in many others in Europe and in the U.S.A., leads to an extension of nursery school 'learning-by-play' methods in the first year or eighteen months. At seven he enters the junior school and learning becomes somewhat more formal. The intellectually gifted child forges ahead, the dull child falls back, and the neurotic child often begins to show signs of strain at this slightly increased pressure. The child who through illness has missed a lot of school is also apt to show his confusion resulting from missing the fundamental groundwork. Maladjustment is precipitated rather than caused by school difficulty, since the pattern of the maladjustment, whether shown principally as anxiety, or as aggression, or as a psychosomatic disorder, will in most cases have its roots in the earlier emotional ties.

The adolescent may in fact recapitulate many of the conflicts of the two- to four-year-old stage, and the more so when conflict has been bypassed and left unresolved in this earlier phase. The moodiness and secretiveness, the fluctuations in self-assertion and dependency mark this second war of independence, from which should emerge the fully matured young adult with normal heterosexual interests and ready himself to become a parent.

Psychosomatic Illness

While any combination of symptoms can manifest itself at any age, there are some conditions which seem to bear landmarks of their own, independently of the age at which they occur. It is not always clear why some children appear so readily to substitute physical manifestations for psychological difficulties.

There is the occasional 'gain' from illness, whether this results from an escape from intolerable situations as in the morbidly shy child who is ill before his entry into a new school, or the favour of individual maternal concern. Other psycho-physical disorders seem to link more closely with an immaturity pattern, as in a return to enuresis or encopresis. The allergic group are often volatile and unstable children in other ways, with autonomic over-reactions. But they are also very often ambitious to the point of being perfectionist in the dissatisfaction with self. The combination of obsessional meticulousness with hard driving self-criticism is well known in the adult 'ulcer-type' and seems also to go with the personality make-up of cases of ulcerative colitis. These children seem sometimes to control their excesses of feeling, whether of despair or of hostility at the expense of their own bodies. When they appear placid, it has often the appearance of an hysterical '*belle indifférence*', as if feeling were taboo but illness regrettably inevitable and patiently borne.

The Physically Handicapped

Rather different from this is the problem of the physically handicapped child, whose approach to life is complicated not only by his personal disability, but also by the attitude of those caring for him. Mostly he will have had long periods of sickness and hospitalisation, so that school is at best an incomplete experience. The handicap itself may block the approaches as in the deaf child who fails to acquire normal speech, or in the overall handicap of cerebral palsy which at its worst can prevent almost every activity from its normal consummation. In the child who has never known normal function, the developmental unfolding may be so grossly disturbed as to be mistaken for mental deficiency. In others the drive to overcome the handicap may lead to a kind of ambition where every reasonable plan is scornfully discarded for others relating more and more to a compensatory kind of fantasy. Such children can be literally driven mad, to take refuge in a psychosis, by over-zealous therapists, just as they can be left isolated in fantasy if not enough effort is made to help them link imagination to performance at however simple a level. Often parents will mistakenly feel that some hospital or institution will provide a magic cure, and long separations are endured with the result that the child becomes a stranger to his family. Alternatively, over-protection may lead to abilities lying fallow which could be developed. In all these cases, many of them incurable, a careful assessment of latent intelligence and psychiatric evaluation will enable a fairer assessment to be made.

The Proper Use of the Child Guidance Clinic

It is obvious that if all this clinical material is to be passed through psychiatric clinics, the services will be stretched even further beyond their capacity than is the case at the present time. Therefore, it is important that full use is made of a consultation service which may 'feed-back' into the special school, the paediatric hospital, and the residential institution. For this reason, the value of early consultation for expectant mothers and at the welfare centre is stressed. Nor should the principles of psychologically sound upbringing be the sole responsibility of those who are psychiatrically trained. The mental health of children depends primarily on their parents; but teachers, nurses, and doctors all contribute their share, and require some experience of these principles in their professional education and training. Where a psychiatric department exists, it must be available both for its practical contribution and to be shot at when it takes refuge in esoteric profundity.

The medium of the conference is readily available and critical discussion of the meaning of symptoms and their value to the patient is rarely wasted. Care in diagnosis, and time spent on taking a history can be given in most outpatient departments nowadays, and a great deal of preventive work is already undertaken there. This should be the aim rather than the notion that all psychiatric material must be the province of the psychiatric team. The possibilities of united paediatric and psychiatric teams has hardly been explored, and possibly the greatest deficiency which remains is in the training of medical students. For the young doctor it is of the utmost value that practical knowledge of normal development should be linked with experience in the common deviations therefrom.

MILDRED CREAK

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Chapter 16

VOCATIONAL GUIDANCE

THE term Vocational Guidance (or Vocational Counselling in the U.S.A.) is normally reserved for the procedure used by those who spend most of their time advising on careers, who tackle the problem in a systematic fashion and the basis of whose theory and practice is a psychological one. These vocational advisers may be psychologists, or they may be youth employment officers or careers masters and mistresses in schools.

This systematic approach and procedure is fairly new in this country and owes its origin almost entirely to the National Institute of Industrial Psychology. When Dr. (now Sir Cyril) Burt became head of the Vocational Guidance Department of the Institute in 1922 he at once began to combine the practice of vocational guidance with research investigations. The practice of vocational guidance at the National Institute of Industrial Psychology incorporated certain features which, although there have been considerable modifications in detail since the 1920's, remain essentially these:

The parents, on deciding that their child needs vocational guidance, get in touch with the Institute. A vocational adviser is allocated to the case and he immediately asks for reports from the head of the school and if possible from the form teacher and the house-master. The parents, too, are asked for a full report giving health history, development, special interests and similar information. (Some very useful reporting forms, which really do help the reporter, have been developed over the years.) The child then comes to the Institute, preferably accompanied by the parents, who can enlarge on any of the material provided in their report. The boy (or girl) is interviewed at considerable length, fills in questionnaires on his interests, hobbies and preferences and is given several tests. Nowadays, and particularly as a result of the research work carried out on service men and women during the war, tests tend to be restricted to these factors: general intelligence, verbal facility, mechanical comprehension, spatial perception and attainment in English and mathematics. (Elaborate performance tests involving the use of complicated apparatus give disappointingly small additions to the material gleaned from the pencil-and-paper tests.) By this time the vocational adviser will normally be in a position to formulate and discuss with the boy some suggestions of possible jobs. The vocational adviser then drafts his report which is discussed with the boy and his parents, preferably at another visit rather than by correspondence.

The vocational adviser will have been able to form a clear, and in most cases, an accurate, picture of the child. (He will probably have found it helpful to collect his material under seven headings: physique, attainments, general intelligence, special aptitudes, interests, disposition and circumstances.) He will also have at his finger-tips or in handy references very considerable information on careers. What is just as important, and scientifically even more important, is to have a considerable body of evidence indicating which kinds of jobs are more, or less, suitable for people possessing certain characteristics. This no one has in any clear-cut form. There are some obvious negative indications—for example that a very shy person would probably not do well in, or enjoy, careers X, Y, and Z; that people whose intelligence is below average would have to toil superhumanly to get any kind of university degree; and so on. On the positive side, as the indications tend to be less obvious they wander away from good scientific validity. The nearer a person gets to being a very good all-rounder, the more difficult is the task of the vocational adviser. The validation of job standards is not an easy matter and it is scarcely surprising that comparatively little progress has been made. Two current research attempts sound hopeful. The first is to find the 'critical requirements of the job' and this involves discovering the reasons for people failing in it. One could thus hope to arrive at the *relevance* of particular personal characteristics to particular jobs or groups of jobs which are psychologically similar. The second approach is to try to discover the ranges of intelligence, attainment and background of people already doing a certain job: the minimum of these indicates the minimum standard for that job. It is plain that it will take a long time to cover an important part of the occupational field when one considers the difficulties. First, there are very few research investigators. Second, firms are, understandably enough, not eager to allow psychologists to test, interview and collect detailed personality descriptions of their employees, nor are they often willing to disclose which of these employees are good, bad and indifferent at the job.

If this aspect of vocational guidance (as practised by psychologists at the National Institute of Industrial Psychology or elsewhere) is not nearly as scientific as it should be, it is fair to ask where the scientific basis of vocational guidance is to be found. There are two aspects, one global and the other highly specific, which have been validated. The global approach has been to follow up those youngsters who took vocational advice and compare their success (in terms of satisfactoriness and job satisfaction) with (*a*) that of the youngsters who did not accept the advice and (*b*) that of control groups of school-leavers who were given no tests or long interviews but who had been given vocational advice on the usual basis of scant information. The greater success of those who, after full vocational guidance procedure, follow the advice has been clearly demonstrated by several investigations. The more specific aspect of vocational guidance which has been submitted to validation is the testing of the tests. Reputable vocational advisers use only those aptitude tests which have reasonable correlations with criteria, the criteria usually taking the form of performance in jobs which appear to require that particular aptitude.

The Youth Employment Service. Before 1948 rather less than half of those leaving English local authority schools were entitled to receive some kind of vocational guidance from the juvenile employment officers (as they were called) of the local education authority. The rest were in areas where the Ministry of Labour was responsible for this. In Scotland, only one authority (the city of Edinburgh) and in Wales only three (Cardiff, Merthyr Tydfil, and Swansea) exercised these powers; the rest of Scotland and Wales was the responsibility of the Ministry of Labour.

In 1945 the committee on the juvenile employment service under the chairmanship of Sir Godfrey Ince was set up with the object of considering measures necessary to establish a comprehensive juvenile employment service and to make suggestions for a practicable scheme. The greater part of the report of this committee (generally referred to as the Ince Report) was embodied in the Employment and Training Act, 1948. The most important provisions of this Act were:

(i) Local education authorities were to be offered a last chance to take over responsibility from the Ministry of Labour;

(ii) The grant to local education authorities from central funds for the running of the service was to be considerably increased;

(iii) A Central Youth Employment Executive was to be set up to help, inspect and supervise the working of the service throughout the country.

In fact, as a result of the offer, many more local education authorities accepted responsibility for the Youth Employment Service (as it has come to be called) and the majority of school-leavers are now in areas covered by their vocational guidance staff.

Where the local educational authority is responsible, the youth employment officers are members of the Director of Education's staff and their offices are housed in buildings of the local authority; in the Ministry of Labour, the youth employment officer is a civil servant on the staff of the Exchange Manager, and his office forms part of the Labour Exchange. The youth employment officer, whether education authority or Ministry of Labour, (*a*) reports to a local committee composed of representatives of the local education authority, employers, teachers, workpeople and others interested in the welfare of boys and girls, and (*b*) is helped, inspected and supervised by the Central Youth Employment Executive. The staffing of a local youth employment service is usually of the order of one youth employment officer for each 600 to 1,000 school-leavers annually. In cities the officers are usually in one bureau, in counties they are sited at strategical places throughout the area.

The procedure, although not standardised, follows a pattern which had been advised by the Central Youth Employment Executive. The headmaster of a local education authority school sends in to the youth employment officer an estimate of the number of school-leavers that term. The officer visits the school and gives his 'school talk' to the assembled children. He advises them to think about jobs and to discuss the matter with their parents, he runs over the kinds of jobs available—not only local jobs—and announces that he will be back to see them all individually. He may supplement his talk with visual aids, exhibitions, special talks from experts on particular jobs and may arrange visits to work places. By the time he returns to the school a few months later there has been completed by the teacher a report on each school-leaver. This report is on a standardised form and allows for these entries: a statement of the pupil's good, average, and weak subjects; a rating of general ability on a three-point scale; a statement of any positions of responsibility held and of any other achievements; a report on special aptitudes, *e.g.* mechanical; a statement of the pupil's health, *e.g.* vitality, obvious disabilities. The teacher is ready to supplement this orally when the youth employment officer consults him. At the interview with the child the officer may have a teacher with him and/or a parent. Some officers see the child first and have a consultation later with teacher and parent. At the interview, the officer hopes, in about ten minutes (the average time he can allow himself) to round off the picture of the child and to come to agreed conclusions about the type of work to be sought.*

No definite vacancy—*this* job, *that* firm—is offered on this occasion; it is at a further (very short) interview at the Youth Employment Bureau that the youngster is told of particular vacancies. The vacancies are obtained from employers who are, however, not obliged to notify them to the youth employment officer, nor need employers fill them via the Youth Employment Service. It will be seen that the success of the youth employment officer is to a large extent bound up with the confidence that employers have in him and this, in turn, is dependent on the efficiency which the officer has shown in the past. The employer is under no obligation to take any of those who have been selected by the youth employment officer as 'possibles'; he may reject all of them and fill the vacancy from some other source.

When the school-leavers are settled in their jobs, the youth employment officer has the continuing responsibility of trying to keep track of them until they are eighteen. This review of progress is carried out by various methods, *e.g.* by holding open meetings when all are invited to call in, by correspondence and by calls at their places of work (although the last is discouraged except in special circumstances). The progress, if it can be called that, of the 'grass-hopper' is, of course, constantly under review, without any special effort on the part of the youth employment officer—but neither he nor his more stable contemporary is *obliged* to use the service or to accept any vocational advice offered.

The shortcomings of the service are, in the main, due to financial restriction but some are caused by other factors. The chief limitations of the efficiency of the official vocational guidance service for school-leavers are these:

1. The absence in most schools of a clear policy of, and procedure for, collating material on the child which would be useful to the vocational adviser.

2. The limitation imposed by the Employment and Training Act on the nature of the material which can be passed on to the youth employment officer. For example, the teacher is not allowed to record in writing anything about the child's personality, temperament, background, and interests.

3. The absence of test results from the standardised report form. This is not due to limitations imposed by the Act, but more to (1) above and to scepticism about the value of tests.

4. The inadequacy of the ten-minute interview at the school. This is basically a staffing problem and a result of the speed with which youth employment officers must operate to cover their assignments in the allotted time.

5. The almost complete absence at the centre (C.Y.E.E.) of a research outlook. It can be argued that it is the function of the universities to carry out research, but it is unfortunate that, for example, no large-scale follow-up is being sponsored by the C.Y.E.E.

6. The inadequacy of the 'coverage' of grammar schools in England and senior secondary schools in Scotland. To some extent this is due to shortage of staff

* Excellent pamphlets on careers are provided by the Central Youth Employment Executive, and youth employment officers often supplement these by compiling job-descriptions of trades and professions within their own area.

in the youth employment service but it is also, in some cases at least, a reflection of the attitude of the heads of these schools to the youth employment officers.

Looking to the future, the kind of vocational guidance service required to fit the needs of our school-leavers might be outlined as follows:

1. Secondary school organisation would allow for staff and time to collate on each child material which would be relevant for vocational guidance. This material would be recorded in a systematic fashion, preferably on a cumulative record card. This would provide a useful basis for continuous educational guidance throughout the child's school career. As aids to both educational and vocational guidance, tests would be given at certain points in the child's school life (possibly at seven, ten, and fourteen years) and their results recorded.

2. At the beginning of the school-leaving year a careers master or mistress would show increasing interest in the child's records, would get to know the parents and their wishes and hopes, and would have throughout the year several formal and informal interviews with the child. He would also be responsible for careers information (books, pamphlets, films) and for arranging visits to places of employment, where this is not already done for ordinary educational reasons.

3. Well before the child was due to leave, the careers teacher would have, in most cases, clear ideas about the *kind* of job for which the child appeared to be suitable. In other cases, he would have agreed with the parents, headmaster and child that the best guidance to offer would be for the youngster to remain at school, or transfer to a more specialised educational institution; in other cases again he would be doubtful about what kind of advice to offer and would present the whole picture to the youth employment officer in the hope that together they could find a solution. Whatever the stage reached by the careers teacher in his preparatory vocational guidance, the youth employment officer could best employ his limited time at the school by briefing himself with the information garnered by the careers teacher and discussing it with him. The officer would certainly need to interview the child at school, if only to get to know him and because he has to have subsequent dealings with him; but he would not have to attempt the impossible task of assessing the child's abilities, aptitudes, interests, temperament and the like, all in ten minutes. The youth employment officer could thus concentrate on the important task of interpreting all the available material in terms of guidance to actual jobs.

Vocational guidance at Industrial Rehabilitation Units. The Ministry of Labour and National Service has twelve Industrial Rehabilitation Units in England, Scotland and Wales in or near large cities. The purpose of the Industrial Rehabilitation Unit is to provide a rehabilitation course for men and women who have been ill, injured, or unemployed for a long time. The chief activities are woodwork, engineering, arts, crafts, gardening and gymnastics: no vocational training is given. In addition to the occupational supervisors and the remedial gymnast there is a team of five who are particularly concerned with assessing the trainees' fitness for work or training. These are: the Rehabilitation Officer (who is in charge), the Medical Officer (who attends part-time), the Vocational Officer (a psychologist), the Disablement Resettlement Officer, and the Social Worker.

Soon after entering, the trainees are given two intelligence tests, and tests of arithmetic, mechanical comprehension, mechanical information and spatial perception. They are interviewed, usually in the third week, for about an hour by the vocational officer who normally has at that time reports from the medical officer, the occupational supervisor and the social worker. Towards the end of the course the recommendations for employment and training are discussed at a meeting of all five members of the team plus the Chief Occupational Supervisor. The recommendations are based on all the information available.

Other vocational guidance centres. Roffey Park, an independent rehabilitation centre in Sussex, and the Belmont Hospital in Surrey, are doing work similar in nature to that of the Industrial Rehabilitation Units.

Most university departments of psychology give a little time to vocational guidance, but only London (Birkbeck and the Institute of Psychiatry), Liverpool and Edinburgh have developed it to the point of having staff and time clearly devoted to this part of the applied field. In these four university departments vocational guidance practice is integrated with teaching and research. Research is being concentrated at present on four problems: (i) the reliability and validity of interviewing; (ii) classification of careers into psychologically realistic categories and levels; (iii) criteria of job satisfaction and satisfactoriness; (iv) the employability of the feeble-minded. These, together with large-sample follow-up of groups given vocational guidance within the Youth Employment Service, are the chief current research needs. Development work is also under way on (*a*) the building up of batteries of cheap and valid aptitude tests, and (*b*) job-description methods which can be easily used by youth employment officers.

Summary

Vocational guidance as a systematic procedure with a psychological basis has existed in Great Britain for only forty years or so. It began with the National Institute of Industrial Psychology which continues by training courses and conferences, by research and publications to develop its study and practice. The main elements in the procedure are these: reports from whoever is in a position to know the youngster well; tests, particularly of intelligence, vocabulary, mechanical comprehension, spatial perception and attainment in English and mathematics; questionnaires and attitude scales; interviews and, later, discussions on possible careers with parents and child; a detailed report carrying recommendations. Follow-up has shown that the overall procedure has a high validity.

The largest 'official' vocational guidance system is the Youth Employment Service, run in some cases by the local education authorities, in others by the Ministry of Labour and National Service. The procedure has these characteristics: a talk to school-leavers by the youth employment officer; a call, later on, at the school to receive a report on each child; a discussion with the teacher and then short interviews. At this stage he usually formulates a general recommendation which he makes more specific when the child calls at the Youth Employment Bureau. He continues to exercise a certain measure of supervision over school-leavers until they are eighteen. The whole procedure could be considerably improved by the school staff playing a stronger part in the preparatory vocational guidance before the youth employment officer appears at the school.

Industrial Rehabilitation Units combine vocational guidance with rehabilitation for industrial casualties. Roffey Park and the Belmont Hospital carry out similar functions.

A few university departments of psychology combine vocational guidance practice with teaching, training and research.

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Chapter 17

PRESENT AIMS AND PROBLEMS IN EDUCATION

Our view of man's nature and destiny, our religious, political, and social allegiance, our economic status in the community, whether we work with hand or brain or both, the technological advances and the political and international tensions of our age—all these influences will have some bearing on our aims when we consider the education of our boys and girls. Very often, therefore, the educational aims of a particular individual are by no means the result of a cold examination of community needs; too often they are the offspring of subjective thinking tinged even with class and personal prejudice. Nevertheless, in all modern democratic communities there is one principle concerning the education of the young that has now won general acceptance: this principle is summed up in the phrase 'equal educational opportunity for all'.

The almost universal acceptance of this principle, adopted by every political party in Great Britain as essential for ensuring the full use of the human resources of a democratic community, was the result of what Sir Fred Clark has described as 'the massive social movement of the last two generations'. The principle was re-affirmed in the White Paper of 1943 on *Educational Reconstruction*, issued to stimulate discussion on the momentous Education Bill of 1944:

> 'The Government's purpose in putting forward the reforms described in this paper is to secure for children a happier childhood and a better start in life; to ensure a fuller measure of education and opportunity for young people; and to provide means for all of developing the various talents with which they are endowed and so enriching the inheritance of the country whose citizens they are.'

In this brief statement of a nation's educational purpose two characteristics are to be noted: it is 'child centred'; and the child is recognised as a potential citizen.

But what kind of world is the child to inherit and serve? It is important to answer this question for, as we have seen, the sort of world we live in profoundly affects our educational aims. To-day, we have to admit, children are born into a very disturbed and disturbing world. We have exchanged social stability and spiritual certainty for social mobility and intellectual uncertainty. We know so much but we doubt so much. Scientific and technological advance have brought us closer together but they have also made us more dangerous to each other. In the sphere of government the tentacles of the state have steadily invaded areas of our existence once regarded as private enclaves of personal judgment and action. In the realm of social and industrial organisation, units tend towards hugeness; the conveyor belt has superseded the craftsman's tool; the individual is removed steadily further away from the centre of decision; men are treated increasingly in categories rather than as individuals. These are conditions by no means conducive to the exercise of personal responsibility, but rather to the increase of tension and frustration. Moreover, it has become obvious that amidst the patent virtues of the welfare state lurk debilitating influences that have to be watched: 'You provide the baby; we provide the rest' is a not too healthy slogan for difficult times. Finally, it cannot be said that the prevailing relativity in morals provides adults with the solid moral convictions that would enable them to steer their children confidently through the snags awaiting them when they leave school. A student of the juvenile courts will have noted that to many parents and children morality is merely a device for keeping out of the hands of the police.

But we must count our assets. First among these is the increased awareness among all sections of the community of the paramount importance of education. Central and local governments, with, perhaps, varying intensity of zeal, are determined to rid national education of its 'trail of cheapness'; and the child stands four-square in the picture. There is our vastly increased knowledge, not of the human heart, but of the human body, of the human mind and human society. And there are all the agencies, potentially good even if open to abuse, contributed by science, all close at hand for the service of children, not least the radio and the cinema. That, then is the sort of world in which we plan for the welfare of our children.

It is fortunate that in most democratic communities the theorist and practitioner in education can work amicably together. It is, for example, most significant that in plans for the reform of Scottish secondary education, issued by the Advisory Council for Education in Scotland in 1947, the authors should preface their quite practical recommendations with words like these:

> 'The term "Christian Democracy" holds its own ambiguity: yet better perhaps than any other it summarises the ideals that have governed our thinking about the task of the secondary school. For Christian education means much more than finding a place in the curriculum for religious and moral instruction. It involves acceptance of a doctrine of human nature which courageously applied will determine priority of aim in education, or better still reconcile seemingly conflicting aims; it must enter into all debate on the content of schooling; and, above all, it decisively establishes the child as an end in himself, requiring an approach to him which is patient, persuasive, and at every point respectful of his growth toward personality.'

If the report had left the matter there we should have reasonably asked whether there is not a social as well as an individualistic reference in education. But the authors were well aware that the conflict between individual and society exists and must be resolved, in so far as it can be. They continue:

> 'If the end of education is individual excellence we are led to ask how does the individual life develop, and the answer immediately brings back all the social references and claims that the doctrine of self-realisation seemed for a moment to banish. For the reply must be that selves can develop only in accordance with their own nature and that their nature is social.'

The individual fulfils himself only in community: the situation is reciprocal: good men make a good society; and a good society helps to make good men. This idea lies at the root of all sound thinking on education.

Here, then, in a sober governmental document, is reference to a 'doctrine of human nature' on which is based all the practical suggestions that follow. From this general declaration of the ends of education the more immediate and very varied aims are derived. And these more immediate aims are founded on another principle intimately tied up with our conception of democracy. This is the principle of equality. And I think it may be said that most thinking members of the English speaking democracies would accept both the 'doctrine of human nature' as here stated, and the principle of equality, as reasonable foundations on which to establish an educational system fit to encounter the stresses of the modern world. Democratic man in a democratic society are assumed as given.

Even if agreement goes thus far, however, conflict begins when individuals begin to interpret the meaning of 'equality'. As far as education is concerned we have to be clear about the ways in which men are equal, the ways in which they are unequal, and the ways in which they ought to be treated equally. Although we are now assured that men are not born equal, either in physical or mental endowment, we accept the view that their very humanity demands that in some ways they should be treated equally. We treat men as equals, for instance, in respect of common human needs; we demand for all men equality before the law. And the only way in which we can have equality in education is in terms of opportunity. We therefore recognise the fundamental equalities and inequalities in children by trying to provide, not the same education for all, but the most appropriate education for all. For it is really justice we seek, and this is as near to justice and equality as we shall ever get.

But owing to the extreme difficulty of discovering what is the appropriate education for any individual child we can never be sure of truly judging the individual case. All that the administrator can do is to do his best with the means available. Apart from the problems of selection, which in themselves are the source of much anxiety and unhappiness in both parents and children, we must accept the fact that the ideal of equal educational opportunity is in part illusory, simply because we cannot choose our parents. Equal educational opportunity sometimes leads to social inequalities. The miner's son, if he marries the right wife, may produce a cabinet minister. And dare anyone say that the son of a cabinet minister does not enter life with a flying start compared with the son of a miner? Nevertheless the principle remains: we have to be as certain as we can that its operation ensures the same *care* for all; for the 70 per cent less gifted as well as for the rest. That is the object of the Education Act of 1944.

In our search for justice we must also be aware of the lions in the path. An important book entitled 'Social Mobility in Britain' (Glass, 1954) reminds us somewhat depressingly of the chain-reaction set off by this brave attempt to provide appropriate education for all. Research into present trends in social mobility suggests that apart from the public schools it will be the grammar schools which will gradually establish a new *élite*, but in this case not an *élite* founded on social privilege as in the past but an *élite* much less assailable because it is selected for 'measured intelligence'. Those concerned for the mental health of young people should therefore note the implications of the following statement (Glass, 1954):

> 'Not to have been to a grammar school will be a more serious disqualification than in the past, when social inequality in the educational system was known to exist. And the feeling of resentment may be more rather than less acute just because the

individual concerned realises that there is some validity in the selection process which has kept him out of a grammar school. In this respect, apparent justice may be more difficult to bear than injustice.'

The implication clearly is that there is less frustration when a person can *blame* a system for denying him opportunity than when he has to accept the uncomfortable judgment that he is not as worthy of social advancement as he thought he was. Increased social opportunity on an I.Q. basis may not, therefore, *necessarily* increase emotional stability in individuals. To be aware of this possibility at least means that the planners of our educational system should relax no effort to ensure that every type of education provided opens up roads to achievement for all ambitious children. We must equally ensure that the social education of young people in grammar schools and universities evokes human sympathy and understanding and a strong sense of social responsibility.

The System in England and Wales

It was the intention of the Butler Act of 1944 to re-form, in the exact sense of that term, the structure of educational provision into a unified and progressive system. Education in childhood and adolescence was therefore divided into three stages: primary, to cover the years from 2·0 to 11·0, including the non-compulsory period in the nursery school; secondary education to cover the compulsory period from 11+ to 15+ (later to be extended to 16+) but also including the non-compulsory period up to 18+; and 'further education', for young people under 18·0 not receiving full-time schooling, who will be required to attend for one day a week, until their eighteenth birthday, a new institution (yet to be established) to be called a 'county college'. The Education (Scotland) Act, 1945, was only required to 'amend' the law as Scottish education was already planned in progressive stages. This was a revolution in our provision for educating the nation's children; secondary education in England and Wales is now free and universal; every child between five and eighteen comes within the provisions of the Act. The meaning of the change can be measured by the fact that whereas in 1913 there were only 174,000 children in grant-aided secondary schools, and in 1938 about 500,000, in 1954 there were over two million.

These two million children have to be sorted out and provided, in the words of section 8 of the Act, with 'such variety of training and instruction as may be desirable in view of their different ages, *abilities, and aptitudes*'. To accomplish this enormous task it has been assumed, as an administrative convenience, with, it must be said, no previous sociological inquiry and little reference to medical and psychological opinion, that boys and girls are ready for the transition from primary to secondary education at the age of 11+; and further, that at this age they may be broadly separated into three categories of ability and aptitude. This decision was, in fact, based far more upon historical than on scientific conclusions; otherwise a later age than 11+ might have been indicated. In 1943 the Norwood Report declared that the history of English education had revealed three broadly contrasting types of child: first 'the pupil who is interested in learning for its own sake, who can grasp an argument or follow a piece of connected reasoning . . .'; secondly 'the pupil whose interests and abilities lie markedly in the field of applied science or applied art'; and thirdly the pupil 'who deals more easily with concrete things than with ideas'.

These assumptions concerning children's abilities and aptitudes have been accepted by the Ministry of Education as the administrative basis of secondary education. We are now committed to the tripartite division implied by the assumed existence of these three categories of children, namely, to three types of secondary education—grammar, technical and modern. But we are not committed to three types of secondary school. There is no mention of such an arrangement in the Act and the White Paper of 1943 clearly stated that 'it would be wrong to suppose that they (*i.e.* grammar, modern, and technical schools) will necessarily remain separate and apart. Different types may be combined in one building or on one site as considerations of convenience and efficiency may suggest'. Whether these three types of education are conducted under one roof or in separate schools, or in combinations of two types, is a matter for the decision of the local education authority. And it is at this point that controversy breaks out, for the decision may affect the happiness of many children.

It may be added in parenthesis that Scottish opinion has rejected the tripartite division of secondary education and decided solidly for the 'omnibus' school, first for the reason that precision in selection is impossible at twelve, and also on the purely educational ground that 'school becomes colourful, rich and rewarding just in proportion as the boy who reads Homer, the boy who makes wireless sets and the boy without marked aptitude for either are within its living unity a constant stimulus and supplement one to the other.'

Three Schools or One

Citizens whose educational aims are more strongly influenced by social rather than by academic considerations, especially those desiring a more homogeneous society, generally support the idea of the 'comprehensive' school in which children of all classes are educated in one large community. They fear, with some reason as we have seen, the emergence of an intellectual and managerial *élite* separated in training, sympathy and interest from those engaged in humbler tasks. Their opponents point to the necessarily large size of comprehensive schools; and the Englishman's suspicion of hugeness in education was not dispelled when the London County Council planned to build 100 such schools of 2,000 children each. Such opinion is reinforced by the fear of the established grammar schools, many of them proudly aware of their long and distinguished educational tradition, of being merged into a system at the cost of their academic effectiveness. The controversy has unfortunately been bedevilled by political allegiances that tend to force the criteria for decision away from purely educational basis. But the fact that it was impossible to create a new system on a cleared site, the existence of so many grammar schools firmly established in prestige and achievement, and the naturally conservative character of the English citizen have resulted in improvisation and compromise. All types of school and combinations of types are emerging in a typically British way. Very few large comprehensive schools as yet exist although they are slowly appearing; there is great need for more technical schools before a satisfactory balance in the system is achieved; and although superb modern schools can be seen up and down the country, thousands of children are educated in comparatively slum conditions. Much building has to be done during the next twenty years before our children are to enjoy the physical surroundings essential for a full education.

It must be noted, therefore, that a good deal of our planning is still in the realm of our hopes rather than of our achievements. And when the new schools are in existence we still have to learn how to use them. The technical schools have to achieve the esteem now accorded to the grammar schools, which they will only do if they can reconcile technical instruction with the claims of a generous liberal education by a manner of training that inculcates aesthetic and moral standards in the process of making things for human use. And what of the 70 to 80 per cent of children allocated to secondary modern education? Here are the great mass of the future citizens of our country, not the leaders but the general body of useful people who do so much of the world's work. The spread of ability in the 'modern' school is very great, ranging from border-line grammar school standards to that of eleven-year-olds who cannot read. Here the teacher undertakes no light task. He realises that the approach to learning with these pupils must be radically different from the academic work of the grammar schools, involving the alliance of much practical with mental activity, the cultivation of taste and understanding through media where feeling as well as intellect is in full operation, and the application of science and social studies to the familiar affairs of everyday life.

There is also a quite special problem associated with the education of the less gifted child who cannot be educated through the formal presentation of ideas. When we have made certain of his basic literary skills and ensured that he associates school activities with his immediate future occupation and have thereby enlisted his emotional drives, we have also to ensure that he enters his working life with what we can best describe as an educated unconscious. For the intricate interplay of hand and mind inseparable from the work of the fine craftsman has little place in modern industrial life. The conveyor belt is not a particularly civilising medium. In mass production two lives are being lived at one time in one person—a nut-tapping life and a dream life. Here the problem for education is—how shall we enrich the young worker's dream life? That is a question we must leave his teachers to answer. A corollary to this need in a future when, we hope, schools may claim a higher priority than dollars and guns, is the necessity of educating the young worker to accept the benefits of part-time education as a natural extension of school and work. Briefly, we should aim at a situation where post-school satisfactions are informed by in-school emotional experience.

Sources of Tension

By establishing the principle of secondary education for all, and by substituting for the narrow path to social advancement the broad way of allocation to several types of secondary school, we have created new sources of emotional strain on parents and children. At the outset we may as well admit that some of these tensions are inseparable from any educational system, not least from one that aims at a fair deal for all.

In the first place we must recognise that the grammar school still retains the highest esteem of the ambitious parent. In principle, primary school pupils are 'allocated' to the secondary school appropriate to their 'abilities and aptitudes'; but parents and children, and, unfortunately, many teachers, still think in terms of their children 'winning scholarships', or failing to win them, at the local grammar school. For thousands of children the annual selection tests at 11+ are a source of great nervous strain which is only increased by parental anxiety. Hence the unsuccessful child may be depressed by a sense of personal failure—'I am now among the duds' is a not uncommon judgment of a child on himself after the crucial week of allocation. Through this entirely impartial system of selection members of the same family may be allocated to different schools. Nor is the position made easier by the fact that in one locality, owing to inadequate provision, the grammar school intake may be as low as 11 per cent, whereas in another it may be as high as 30 per cent. The average intake is about 15 per cent of the 11+ population.

The impact of this situation on any particular family will depend largely on the cultural outlook of the parents. What exacerbates the feelings of the parent who is willing to make any sacrifice for his children's education is that he is free to buy a television set, which may be harmful to his child, but he is not free to buy education that will be good for him unless he can afford to send him to an expensive boarding school. The fallacy in this argument, of course, is the possibility that the education the parent desires is not necessarily appropriate to his son's ability. Nevertheless, his discomfort is not allayed when he becomes aware of the high percentage of pupils who leave grammar schools before they have completed the full course, thereby dishonouring an implied obligation. Thus do individuals suffer through the application of a wholly commendable principle of social justice.

On a purely statistical basis present methods of selection, by intelligence and aptitude tests, tests in English and number, and school report, are reasonably satisfactory. But we are forced to the view that even the most delicately devised tests will always leave a margin of error in the prognosis of a child's total educable capacity. We can be certain of the upper and lower ranges of ability, we can hope in time to reduce the space between them, but we can never hope to draw a line between those who must be in and those who must be out of any particular type of secondary schooling, for 'we are attempting judgment in a field in which certainty of judgment is unattainable' (Jeffrey, 1953). For a generation at least, and perhaps for much longer, the emotional strains involved in selection procedures will persist. Some of them will be eased by better school provision; by a greater public appreciation of the principles involved; by improved methods of selection; by greater elasticity in systems of transfer from school to school; by a more generous provision of teachers and by smaller classes; but above all by imaginative developments in the schools themselves warranted to evoke the growing capacities of boys and girls and set them on the way, through a happy and industrious childhood, to a good start in life. But all strain will not be removed, and moreover need not be removed, from a situation where individual ambition and aspiration clash with the impartial operation of a principle.

Other sources of unnecessary strain among schoolchildren lie within the schools themselves. Among these may be anxiety concerning examinations, especially where the child of mediocre talent is additionally burdened with over-anxious or ambitious parents; excessive competition in the class-room (it is best that a child should compete only with his own inertia); association with pupils of greater ability; incompatibility of teacher and pupil; and the inability of a weakly or sensitive child to stand up to the rough-and-tumble of school life. On the other hand misbehaviour and poor work are as likely to result from too easy as from too difficult study. Accurate grading (often difficult in a small school), the situation that produces good work with a little but not too much strain, where successful effort engenders its own encouragement and establishes its own confidence, where the authority of the teacher and the freedom of the pupil are in harmony, where as many children as possible are doing things they want to do and can do, and where each child feels some responsibility for his own progress—this kind of situation is likely to produce effort without unnecessary tension in the class-room. And, what is more, problems of discipline will loom less ominously in the school.

Schools to-day are far happier places than they used to be because teachers are more civilised, more humane, more sensitive to the total nature of the child, more alert to the manifold resources of a child's energy and more willing to use them. The rod, once the normal magisterial insignia and the inseparable adjunct to learning, more often than not lies mouldering in the cupboard. The good teacher now knows that good discipline depends on good teaching, and good personal relationships. He is prepared to give more place to practical and aesthetic activity, he more often sees 'subjects' as fields of human endeavour, he brings the world into the class-room by taking his pupils out of it, he serves his pupils on the playing-field and in the countryside, and he realises, more than was ever realised before, that a school is a community of persons whose purpose is to provide the raw material of moral and social experience. The best schools are aware that the child's first need is security and that security comes from the child's association with mature and disinterested personalities. And the best teacher is he who exercises an unremitting and unsentimental care for children. But lest too rosy a picture is given of present conditions we must emphasise that we are referring only to the best teachers and the best schools. There are still too many miserable school buildings, and too many mediocre and indifferent teachers, to permit any complacency to enter into our views of contemporary education. We must hope that in both equipment and staffing more schools will become more like the best. Then they will be very good.

One other factor in the situation should be noted, especially by those working in that elusive area between school and home: parent-teacher co-operation improves steadily. Many a school head will agree that the younger generation of parents are less suspicious of the teacher's trade and more willing to discuss their children's problems than were parents thirty years ago. It is all to the good when home and school find themselves in partnership in the difficult job of rearing the young.

Problems Further Afield

The aims and problems of education discussed in the foregoing pages, although confined to Great Britain, may have some general application to similar problems in the emergent democracies overseas. But medical and educational workers in underdeveloped territories will be faced with situations far removed from the educational scene in Great Britain or the dominions. A few very general observations, therefore, must be added on the problems of fundamental education in these less advanced communities.

Half the people in the world are illiterate; half the people in the world are desperately poor; and most of these men, women, and children suffer from malnutrition and disease. These evils are indivisible; each reacts on the other in a vicious chain of cause and effect. But ignorance is a major factor in their existence. To remove ignorance is to pave the way to better physical well-being, to higher production of food and to better social economic conditions. Only thus can the tragic cycle be broken. Hence the educational aim for the unprivileged peoples of the world is not merely to produce more people who can read and write, although these skills are quite basic to human communication, but to produce people who are able to apply practical skills and knowledge to the improvement of their daily lives.

Schemes of education must, therefore, embody not only school education for the very young but education for the adolescent and the adult; and every effort should be made to avoid the danger of skills and knowledge learned at school fading because they have not been articulated with the needs and experiences of adult life. In the words of the report *Mass Education in African Society* (1944): 'Just as the education of the child must lead up to the development of the adult so must schemes for adult education reach down, as it were, to join hands with the school. The plans made at one level must ensure the fulfilment of activities at other levels.' This is the idea that informs the new conception of educating a whole community, children and adults, at the same time. In this way we may hope to get ignorant people to understand and take part in, and to some extent control, the social and economic changes that affect their lives and to make the most use of the welfare services that governments and other agencies provide.

The details of such plans must be studied in the above-mentioned report; but two important points should be noted: first the success of mass education depends on securing the co-operation of the people it aims to serve; secondly, the material used in the teaching of reading and writing must be such as to stimulate the people's desire to improve and control the conditions in which they live. It has been a criticism of colonial education in the past that it has produced too many clerks. Albert Schweitzer recorded that on an occasion when he was sweating away building his hospital he called upon a native in white clothes who was standing by to come and help—'No,' he said, 'I am intellectual.' Schweitzer commented that the African is in danger of cutting out the stage between primitive life and professional, namely the stages of agriculture and handicraft.

Literacy is a tool; it can never be the end of education. The evil legacy of ignorance and poverty can be dispelled only by the increase of vocational skills—agriculture, building, handicrafts; by education in the laws of personal and community hygiene, especially as they apply to the enemies of health in any particular locality; by simple knowledge of physical, biological, and economic processes; and by the development of social and moral attitudes appropriate to communities changing and growing in a world of change. These things can never come to pass unless the wealthy and privileged half of the world turns in charity to this other destitute half, bringing to it the services of medical and agricultural science and the skill of the teacher in an endeavour to help it to help itself.

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Chapter 18

PUNISHMENT

THE problem of punishment arises not only in the case of the maladjusted child or the delinquent. It exists for every child, and faces all parents, teachers and others concerned with the upbringing of normal children almost as much as it does those directly responsible for the administration of the law. Since the culture of to-day is so fluid that there is hardly a single tenet of previous generations which has not been called in question, it is natural that many parents find themselves genuinely at a loss to know what part, if any, punishment should play in the upbringing of their children and in effecting their satisfactory adjustment to the society in which they have to live. Others again start with a strong prejudice for or against punishment based on their own personal experience. A thoroughly self-satisfied parent may adopt the view that as in his own case frequent thrashing (or alternatively minimal punishment) produced such an admirable result, the same methods will be those of choice for his son. Alternatively, a parent may blame his own failures on the severity or indulgence of his upbringing and decide to adopt opposite methods with his own children. Whilst we may sympathise with this type of reasoning, it militates very strongly against any objective assessment of the place of punishment in dealing either with the normal child or the delinquent. Indeed, there is violent divergence of opinion often expressed at the present time as to whether the modern tendency to reduce or eliminate retributive punishment in the home, the school, and the juvenile court is or is not a factor directly responsible for delinquency and behaviour disorder.

In order to reach any impartial judgment on what is obviously a matter of great social significance, it is essential to return to first principles and consider both the philosophy and motivation of punishment, viewed against the background of the particular culture in which the child is to be reared.

The conception of punishment as we know it is closely bound up with the conception of sin. In this sense it is essentially a human attribute, and more particularly one which emerges with the more elaborate organisation of human society. If we start with the basic concept that man is a social animal, who will normally be protected by society so long as he conforms to the particular rules laid down by the community of which he is a member, we find that any behaviour undermining the structure of the group will bring the censure and punishment of the group as a whole. Although a crime such as robbery or murder may be committed against an individual, the tribe will regard a lack of respect of life and property as a potential danger to all. It should be emphasised that most crimes committed within a particular community cease to be regarded as crimes when committed against a hostile group. Murder becomes war, and robbery the capture of enemy property.

Even in adult life, therefore, we are faced with double standards as to what constitutes social or antisocial behaviour, as to what is punishable and what is not. The individual who holds that taking human life is no less murder because the act is committed in uniform is, in time of war, in an unpopular minority liable to stigma and persecution by the herd; whilst the man who is aggressive, reckless or even suicidal may prove an outstandingly gallant soldier, but is liable to run into violent collision with society when these qualities are no longer the ones for which society has a need.

War brings out most clearly that in the eyes of the community crime is what is inconvenient to the herd at any particular moment, and that there are few if any absolute standards which may not be shifted or modified at will. But apart altogether from war, the larger community, whether this be nation or race, is made up of smaller units whose standards and loyalties may be in conflict with the interests of society at large. Age groups form an important example. Laws are for the most part made and administered by the elders of the community, who, whilst having the somewhat withered fruit of experience, are not always those best able to understand or appreciate the motivation of the young or underprivileged. Two age groups form a particular problem in modern society, boys of the gang age (from eight years onward) and adolescents.

In both of these the group tends to define its own standards of behaviour. Even the youngest group may build up a most elaborately organised society, with officers, laws, punishments, initiation ceremonies, passwords, and rituals. These may or may not conflict with those of the larger society of which the group forms a part, but it is almost inevitable that at some point there will be a conflict of loyalties. Whilst intelligent adults can do much to guide the initiative and growing independence of which gang life is a manifestation into channels which are constructive, or at least harmless, it must be recognised that some breaking-away from adult control is a normal phase of development. Here again there will be double standards—those of the adult world as represented by parents, teachers, neighbours or employers, and those of the 'gang' in which emphasis is laid not so much on orthodox conformity as on adventure and experiment. When as too often happens the environment provides little opportunity for adventure which is not antisocial in the wider sense, the gang becomes a potential source of delinquency. It cannot be too strongly emphasised that the delinquent in this case is often obeying rules and standards of his own group which to his mind are more compelling than those laid down by a larger society in which he feels his place is unimportant and to which he feels little direct loyalty.

This conflict of loyalties is the more understandable, but for the child even more confusing, when he knows that his parents are themselves not wholly or sincerely on the side of law and order. It has become so commonplace nowadays for respectable members of the community to evade income-tax, or to deride the law if they do not openly break it, that it is little wonder if a generation is growing up which is confused and disorientated, with shifting standards and little moral anchorage. Punishment then becomes the reward of being found out, and whilst it may or may not serve as a deterrent, it can do little to reinforce principles which are insecure or non-existent.

The Purpose of Punishment

When we attempt to analyse the motivation and purpose of punishment it becomes obvious that there is no single basic principle involved. In different communities or different circumstances, one or other principle may be dominant, but often there is a confusion of principles which may be obscure even to those administering the law.

Retribution. The most primitive concept is probably that of retribution or vengeance against an individual who has outraged God or his representative, or has injured the community. The Old Testament abounds with stories which read essentially as acts of vengeance—the destruction of the cities of the plain, the fate of Lot's wife, the massacre of the priests of Baal, and the forty-two children who were torn by bears for crying 'Go up thou bald-head!' to Elisha. Applied to secular crimes, the principle is epitomised in 'Eye for eye, tooth for tooth, hand for hand and foot for foot'. Many other religions include vengeance in their theology: the Greek furies pursue the evil-doer, and a host of jealous tribal gods bring calamity on offending votaries. Like most primitive drives, desire for vengeance is still active in present-day society, and becomes vocal immediately public indignation is roused.

In general, acts of cruelty and violence, and sexual offences, are those for which cruel retribution is most violently demanded. The Departmental Committee on Corporal Punishment (1938) received many suggestions of offences for which witnesses considered that flogging should be ordered, but found that the nearest approach to a common factor in these offences (which varied from incest to gross cruelty to animals) appeared to be that they all excited special indignation. The committee concluded that the suggestions were, in the last analysis, based on a purely retributive principle, and could not accept this as a safe guide in determining which offences should be made liable to this form of punishment. One might go further, and suggest that 'special indignation' is itself the worst possible basis on which to administer justice or decide punishment, since it arises from the unconscious and commonly represents the desire for a scapegoat.

A relevant example of the retributive principle in action is to be found in the prison sentences still frequently imposed on parents for cruelty to children or neglect. The child has been made to suffer. The parents must be made to suffer in their turn. The more fundamental question as to whether a prison sentence will make them better parents, or whether their imprisonment will do more harm than good to the child, is apt to be forgotten.

Just how far this primitive desire for vengeance is reflected in punishment is often difficult to assess, since the same sentence may be designed to cover several requirements, *e.g.* protection of society by removal of the offender, and a deterrent to others. However, if vengeance is allowed to influence punishment, it is important that the motivation should not be disguised as something else, since it is liable to be charged with emotional affect and can never represent a wholly cool and impartial judgment.

Restitution. A completely different basis of punishment is to be found in the concept of restitution. This has a real, though somewhat limited, place in the upbringing of children. Wilful (as opposed to accidental) damage can be made good by forced labour or fining, if the damage is not (as too often happens) out of all proportion to the culprit's ability to pay. Most older children will see a certain crude logic in this form of punishment if it is applied sparingly and not abused. Younger children, on the other hand, may be embittered and bewildered by a principle which they cannot fully understand.

Deterrence. The use of punishment purely as a deterrent for the protection of society is not easily demarcated from retribution, since the motivation is so often mixed. Whenever punishment is inflicted, three questions might well be asked. First, is it sincerely expected and intended that the punishment selected will prevent the particular culprit from repeating his antisocial behaviour? Is the punishment, on the other hand, primarily intended to deter others from committing the same offence? Or, in the case of a court sentence or expulsion, is the main purpose to protect society by removing from the community one who has proved himself a misfit or a menace? As to the fundamental question as to whether punishment does in fact serve as deterrent, there can be no simple answer, since the effect must depend on the individual concerned, his stage of development when punishment is inflicted, the agent who is responsible for the punishment, and the nature of the act for which he is punished. There is abundant evidence, for instance, that there is little or no value in repeated punishment of the recidivist or persistent offender, where similar punishment has already been proved ineffective. This is particularly true of corporal punishment. The same will apply when the immediate compulsion to commit a particular act is stronger than the possible risk of punishment. Even when the death penalty could be inflicted for stealing, it was found that a starving man would still steal to provide food for himself or his family. There are recorded figures showing that of 167 thieves prepared for hanging, 164 had already witnessed public hangings for the same crime (Berg, 1959). On the infantile and childhood level, it is commonly found that compulsive acts such as thumb-sucking or masturbation are singularly resistant to punishment as a deterrent.

On the other hand, fear of punishment can undoubtedly prove an effective deterrent when the urge to commit an offence is not overwhelming and when the child is able to recognise a clear relationship between cause and effect. It is probably true that the *certainty* rather than the *severity* of the punishment is the more important deterrent, the fear of punishment diminishing disproportionately if there is even a one-in-ten chance of escaping from it. Its effectiveness will then depend largely on the efficiency of ascertainment.

Vicarious punishment. No consideration of the philosophy of punishment would be complete without mention of what may be called vicarious punishment, in which the innocent is made to suffer for the guilty. It has no recognised part in modern judiciary systems, but occurs again and again in earlier cultures. The sins of the fathers are visited upon the children, the God is killed to redeem the world, human or animal sacrifice is used to propitiate offended spirits, and the scapegoat bears away the guilt of the tribe.

A comparatively recent example is that of the whipping boy kept by royal households. Since the person of the boy prince was too sacred for the slipper or the tawse, punishments for the prince's escapades were visited on a little commoner of the same age. We know that as a child Henry VIII had such a whipping-boy and the custom survived longer for the Dauphins of France.

Here we have illustrated the belief that sin can only be wiped out by punishment and suffering, and that the offender can be redeemed by the suffering of another. Applied crudely to the administration of justice, the idea would now appear repugnant and altogether unacceptable. But we must remember that by a distortion of the Christian concept of willing sacrifice, a belief in the expiation of sin by vicarious suffering has undoubtedly had a profound influence on the culture of to-day. Like many a belief, the origin of which is lost in the mists of antiquity, it is at least possible that the concept of vicarious punishment is more relevant and more liable to influence our behaviour than we are at first aware. It is not suggested that anyone nowadays would uphold that the innocent should suffer *for* the guilty, but we are perhaps liable to accept far too readily that the innocent suffer *with* the guilty. In the case of children, this applies particularly to the stigma of illegitimacy, and it is significant that nearly all attempts to remove the stigma from the child have been bitterly opposed, usually on the grounds that so doing would undermine morality.

Self-punishment. One further type of punishment to be considered is self-punishment. In its cruder physical manifestations we find examples in the self-mutilations practised by certain religious sects, and the flagellations and mortifications of the mediaeval Christian fanatics.

For the normal adult or older child, conscience is still a strong guide of conduct. He knows that he will feel unhappy and degraded if he embarks on a course of action which he himself realises is wrong. Admittedly there will be many issues in which he does not see clearly or feel that existing rules involve a moral principle. But in general it is probably true that the great majority of mankind conforms to certain social standards not because of fear of punishment from without so much as because of fear of punishment from within. At the other extreme are those unfortunate individuals whose sense of personal guilt is so strong that it may lead to antisocial behaviour directly designed to bring punishment upon themselves. Here then, in self-punishment, is a motivation which if properly canalised may prove a bulwark of stable society: which if distorted may be sterile or make the sufferer a burden to himself and to the community.

The Manner of Punishment

So far an attempt has been made to distinguish as far as possible five types of punishment—retribution, with its high emotional charge, punishment purely as a deterrent, punishment by restitution or atonement, vicarious punishment of the innocent, and self-punishment. From this admittedly over-simplified analysis has been deliberately omitted the pleasure of inflicting pain and suffering for its own sake. This should not be regarded as punishment, since punishment implies that an offence, real or imaginary, has been committed. It does, however, have a vitally important bearing on the way in which punishment is inflicted.

There could be no greater mistake than to assume that we, or any other race, are so civilised that the pleasure in causing suffering has ceased to be a powerful motive. It is probably most openly manifest in adolescents, and the majority of boys' schools where supervision is lax and morale low could provide instances of bullying, beating or torture which would provoke the severest penalties if committed by adults. It has also been found in a number of 'advanced' schools which have attempted self-government, that there is a real danger of punishments designed by adolescents being so savage that adults may have to step in and modify them. It would certainly be unrealistic to assume that such a complete change occurs between adolescence and maturity that sadism, whether open or disguised as something else, is no longer a danger to clear thinking and the objective administration of justice.

It has already been mentioned that crimes of brutality are exactly those which arouse most strongly the desire for vengeance, and one might go further and say that the exhibition of sadism arouses the same passion in the community at large. The desire that suffering should be repaid by suffering is inextricably mingled with *satisfaction* when the offender is made to suffer, and disappointment if he is not repaid in kind. We have probably all heard such remarks as 'Flogging is the only language such brutes understand' or 'Hanging is too good for him; he should be made to suffer', and they are by no means always made by the most brutal and depraved members of society. Without labouring the point unduly, one may say that whatever punishment is used, its purpose and motivation deserve careful examination. Whilst corporal punishment provides the most blatant opportunity for the expression of sadism it is essential to remember that cruelty and vindictiveness can be introduced into almost any form of punishment, and that children can be reduced to a state of misery and ineffectiveness without the infliction of physical pain. A major responsibility rests on those selecting teachers, personnel of children's homes and foster-parents to see that they are temperamentally suited to undertake the care of children. Prescription of the forms of punishment which may be used is not enough; it is equally important to ensure that the manner of punishment is safeguarded from abuse.

Punishment and Social Adaptation

Consideration of the use of punishment in effecting the social adaptation of the child leads in turn to that of punishment of the delinquent where the process of adaptation has failed. We can start from the premise that the infant is not an ethical or social being, and that almost every one of the characters that make for good citizenship has laboriously to be learnt. Whilst many people nowadays would repudiate the doctrine of original sin, the study of the young child does at least make it possible to see how such doctrine has arisen. Described in adult terms, it may be said that the infant is normally greedy, self-centred, uncontrolled both physically and emotionally, agressive, destructive, sexually curious and exhibitionist, and with no respect for personal property. When speech has been acquired, phantasy is so confused with fact that for some considerable time there is little conception of 'truth' in the adult sense.

All these things are normally forgiven to the infant because it is realised that they represent normal phases of development: but any one of them may become a highly anti-social failing if it persists to an age when it should have been outgrown. How, then, does social adaptation normally come about? To a large extent it will be by imitation, the child tending to copy the behaviour patterns of older children or adults. But at least during the first five years of life, the parents (or those standing in a parent-relationship to the child) will play a positive part in moulding behaviour and more particularly in establishing moral or ethical values. Gorer (1948) has described the classical method of training in most cultures which develop a moral character as follows: 'by giving love and reward when the children conform to arbitrary moral standards, and withholding love or inflicting punishment when the children fail to conform'. (He points out, however, 'that the method is not universal and that in many societies parents maintain an even attitude towards their children, using the neighbours or the wrath of imagined or impersonated supernaturals as instruments of discipline'.) In our own culture, the former method is the one generally adopted, though threats of an all-seeing God, of policemen or sweeps who will take the child away, bogeys, doctors and the like still play a part in some parent-child relationships.

The emphasis placed on reward and approval, or alternatively on disapprobation and punishment, will vary from parent to parent, and will also depend to some extent on the child's place in family. The first child will tend to receive more of the mother's time, attention, and encouragement than will later-born children. These in turn will tend to learn more by imitation of older brothers and sisters, and to be included in the play of slightly older age groups, which in itself is a highly important factor in social adaptation. Here again reward and punishment will be clearly manifest. The youngest will be admitted to the play-group on sufferance. If he conforms to the rules he will be encouraged and given more important roles to play; if he relapses into tears or temper he will be temporarily excluded.

An observant and sympathetic parent will not only know how much to expect of a child at each phase of development, since she has watched each skill and behaviour-pattern gradually acquired, but will realise that the behaviour at any given moment is the product of the living past. The child has not, in short, jettisoned the stages of development through which he has passed: they are an integral part of his present make-up, though they may not be obvious in his immediate behaviour to anyone who has not followed his previous progress. Again, the parent will realise that the child's hold on each new developmental skill is at first precarious. Under stress—whether of illness or unhappiness—he will be liable to relapse to an earlier phase. To take a concrete example, most children will gradually become dry at night during their third or fourth year, and lapses will become less and less frequent. If the child is severely upset, however, either emotionally or physically, it is not uncommon for enuresis to recur after the child has been completely dry for a year or more. In such a case punishment can do much harm, since the child requires more rather than less affection and security at this time, and attention should be directed to the underlying cause of the relapse.

If we are to draw any useful analogy between the delinquent adolescent and the child who has either failed to reach a particular stage of social adaptation or who has relapsed we must examine more carefully the basis of parental punishment before generalising about the treatment of the adolescent or adult. In the first place, the necessity for, and the effects of, punishment of the child will depend to an overwhelming extent on the basis of the parent-child relationship. A satisfactory parent-child relationship may be defined as one in which there is harmony between the parents themselves without split discipline; where the child is secure in the knowledge that the parents' basic reaction to him is one of love and confidence, and where the child is able to express his affection in return. It is almost equally important that the parent or parent-figure should be able to receive as well as give affection if the child is not to feel snubbed and thwarted.

If the satisfactory parent-child relationship exists, punishment by a parent will be painful but not intolerable. The child will realise instinctively that a quarrel with a parent, however wounding it may be whilst it lasts, will be followed by reconciliation and reassurance. Indeed, one may often see a young child trailing his coat and inviting punishment, who will obviously feel frustrated and disappointed if he fails to evoke the reaction he expects. Although a more complicated explanation of this reaction has been offered, we can accept a somewhat simplified interpretation. The child feels both love and hostility to his parents in different degrees, though affection will normally be paramount. He rightly assumes that both reactions are felt to him by his parents also, the first manifested by affection, the latter by scolding or punishment. When his fear of his parents' hostility assumes frightening proportions, he may actually wish to provoke punishment in order to reassure himself that this is neither so terrible nor so long-lasting as his fears suggest, and, most importantly, that it will be followed by reconciliation and renewed affection. It is, fundamentally, reassurance and affection that he is seeking, though the route is circuitous.

In the case of a child where the parent-child relationship is unsatisfactory, and where he feels himself unloved and rejected by one or other parent, punishment assumes a much more frightening and damaging role. Instead of being an incident superimposed on a background of underlying affection, the child will feel instinctively that it is an expression of the parents' basic hostility. Every time that he is punished without satisfactory reconciliation he becomes further estranged from the parents and more confirmed in his feeling that their underlying attitude is one of disapproval and hostility.

It is now possible to make two important generalisations. First, when the parent-child relationship is a satisfactory one based on mutual affection and respect, *punishment is likely to be most effective and least often necessary*. Secondly, when the parent-child relationship is unsatisfactory and the child feels insecure and unloved, *punishment fails to achieve its object because it is interpreted as one more evidence of parental hostility*. This in turn tends to lead to excessive and repeated punishment, to which the child reacts either with defiance or an apparently 'don't-care' attitude. This 'don't-care' reaction is the despair of many parents who fail to realise that it stems from something deeper than a reaction to punishment itself. It is really the child's defence against something which is in fact intensely painful and damaging, namely the basic lack of parental affection. Here again punishment becomes an incident, but in this case is seen against a background of hostility with which it merges, and which the child feels himself powerless to change.

The parent-child relationship and the child's early reaction to punishment are fundamental to an understanding of the individual reaction to punishment in later life. To a great extent the child's attitude to adults in general and later to society will be coloured by his early attitude to his parents. If his parents, and particularly his father, have been disliked and distrusted, this attitude will tend to be projected first on to his school teacher and later on to any adult having authority over him. Since a hostile attitude can, at least to some extent, be overcome during the early school years, and a healthy attitude damaged, a very great responsibility rests on teachers at the nursery-school or infant-class level. Fortunately this responsibility is now widely recognised and accepted. If the child's confidence and affection can be won as soon as possible after entering school, his attitude to learning (receiving instruction and direction and giving attention and interest) will be started on the right lines. This in turn will greatly ease the task of teachers at later stages. If, on the other hand, the child's hostility is aroused or confirmed when he first enters school, he is much more likely to carry through an attitude of hostility and defiance into the later school years, becoming one of those whose main object seems to be to upset the class and make the teacher's life intolerable. With the excessively large classes which are still too common, it is almost inevitable that children of this type evoke a steady stream of punishment from harassed teachers suffering continual interruption and distraction. Unfortunately such punishment is apt to defeat any but its immediate object. It may make it temporarily possible for the majority to continue the lesson, but it does little or nothing to turn the rebel into a willing member of the class. This applies particularly to corporal punishment in the class-room, where the continual offender very soon becomes hardened to it, and may even turn it to his own ends by posing as a hero. The deterrent effect it may have on others must be offset against the hostility which it arouses. The principle of applying corporal or other punishment to educational failure which may prove to be due to inferior intelligence, defective hearing or other disability is so manifestly unjust and harmful to educational progress that it should hardly require mention if it were not still retained by some inept or insensitive teachers. It does, however, illustrate the potential danger of placing on the same individual the responsibility for both discipline and education, and the risk of the two becoming confused.

It is not suggested that there is any simple answer to the problem of punishment in school, or in avoiding the conflict of interests of the rebel and the majority. But it would seem that the logical approach is not primarily through punishment itself, but in reducing the size of classes and making possible a greater degree of attention to individuals. Where the causes of anti-social behaviour, inattention, and educational failure can be uncovered, there is much more hope of treating them satisfactorily than by any rule-of-thumb system of punishment. When punishment is used, it should be aimed at bringing back the offender into the group and not further estranging him from both group and teacher. It is important for both teacher and child that the motivation, necessity and effect of the punishment should be considered objectively. It will not only be useless but actively harmful to persist with methods which have already helped to render the child anti-social.

The case of the delinquent is considered more fully in the following chapter. Obviously all children who come before a juvenile court are not in the same category, and when it is remembered that playing football in the street or bathing naked in a canal may be punishable offences, it will be realised that a summons does not necessarily imply moral turpitude or emotional maladjustment. Unfortunately, however, many of the older and more persistent offenders do in fact represent examples of damage having been done before the age of five which has not subsequently been rectified. The concept of a hostile society to which no loyalty is owing is so deeply entrenched that neither punishment nor attempts at rehabilitation are likely to prove permanently effective. Here again we have in essence the case of the unloved child, to whom punishment is one further proof that the parent or, in this case, society rejects him.

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Chapter 19

JUVENILE COURTS

THE present structure and procedure of the juvenile courts dates from the Children Act of 1908* with various modifications introduced by the Children and Young Persons Acts, 1933 and 1963. Some of the alterations proposed by the Ingleby Committee (1960) were implemented in the 1963 Act. Subsequently the more revolutionary Kilbrandon Committee (Scotland, 1964) recommended that young people under sixteen should be removed from the jurisdiction of criminal courts. The existing juvenile courts should be superseded by juvenile panels which should have referred to them children in need of special education and training and power to order such measures as seemed to be required. There should be a right of appeal to the courts in disputed cases. In 1964 the then Government set up a Royal Commission on the Penal System and asked it to deal first with young offenders. In the spring of 1965 the Government announced its intention of introducing major changes in the law relating to children and young people under twenty-one, and in treatment methods for young offenders. Information about these changes is not so far available and thus the following description is based on existing practice. A summary of the proposed changes forms a postscript to this chapter.

All charges against children (10 to 14) and young persons (14 to 17) are heard in specially constituted juvenile courts, except where a juvenile† is charged with an adult, when the case may be heard in the adult court but remitted to the juvenile court for sentence. The juvenile courts thus have jurisdiction in every offence except homicide. The minimum age of criminal responsibility is ten, and children above that age may be charged with any offence which would be punishable if committed by an adult. There is of course a right of appeal to a higher court against a juvenile court's decision. There is also a right to apply for free legal aid.

The juvenile court bench consists of three lay magistrates (one of whom must be a woman) elected to serve on the juvenile court panel by the whole body of magistrates for the area (except in London where they are appointed by the Lord Chancellor). One acts as chairman and conducts the proceedings. They are assisted in legal matters by the clerk to the court, who, however, must in no way influence their decisions. The retiring age is sixty-five. Lay magistrates are drawn from varied professions, and the aim is to recruit to the juvenile court panel those who have wide experience of young people, sympathy with them and an ability to talk with them and their parents in terms they can understand.

The juvenile court may sit in the same building as the adult court though not at the same time. A few have their own premises but many sit in other, and sometimes most unsuitable, buildings. The public is excluded, and, though the Press has the right to be present, it may not publish names, addresses or photographs of juvenile offenders except by permission of the court in an individual case. Adoption proceedings, which are heard *in camera*, will not be dealt with in this article.

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* All the information in this chapter applies only to England and Wales.

† The terms 'juvenile' and 'child' will be used to cover both children and young persons.

The following non-criminal proceedings are also heard in the juvenile courts:

(i) Care, protection or control proceedings. The police, the local authority or the N.S.P.C.C. may bring before the juvenile court anyone from infancy to the age of seventeen (the minimum age is dictated by commonsense in the individual case) who is in need of care, protection or control because he has no parent or guardian or because he is not receiving such care, protection or guidance as a good parent may reasonably be expected to give, and is falling into bad associations or exposed to moral danger; or because the lack of care, protection or guidance is likely to cause him unnecessary suffering or seriously affect his health or proper development. These proceedings also relate to those against whom certain serious sexual or violent offences have been committed or who are members of households where such offences have been committed. Charges in relation to these offences are heard against the adult in an adult court and the child is either brought direct to the juvenile court or else remitted to it by the adult court as being in need of care, protection or control. The police, the local authority, or the N.S.P.C.C. may also bring before a juvenile court a child or young person who is beyond the control of his parent or guardian. The parent or guardian may take the initiative by asking the local authority to take the child to court.

(ii) Non-attendance at school. Children of school age who are persistently not going to school may either be remitted to or brought direct to the juvenile court. These cases vary from straightforward 'playing hookey' to complex examples of school phobia.

In criminal charges the offence is explained (desirably in language the child can understand) and a plea of guilty or not guilty is taken. If the plea is not guilty the case must then be heard within the rules of evidence exactly as in an adult court. The procedure is unfortunately often confusing to parents and children, who find it hard to understand the meaning of electing to go for trial by jury, giving evidence on oath, being cross-examined, making a statement, or deciding not to give evidence. The Ingleby Committee deserved the strongest possible support when they recommended that: 'The court should be at pains to explain to both parents and child just what it is doing and why'

In non-criminal cases there is of course no plea, but these cases also must be heard within the rules of evidence. All cases must either be proved 'beyond all reasonable doubt' or else dismissed. It is only after a case has been found proved that the Children and Young Persons Act, 1933, requires the court 'to have regard to the welfare of the child or young person' (Sect. 44 (1)). The result is that the court switches with apparent inconsistency from concentration on an act or situation to concentration on the person involved in it. As the Ingleby Committee puts it: 'The weakness of the present system is that a juvenile court often appears to be trying a case on one particular ground and then to be dealing with the child on some quite different ground. This is inherent in combining the requirement for proof of a specified event or condition with a general direction to have regard to the child's welfare.' The reverse side of the medal is that there could be wide interference with personal liberty and rights unless the basic principle is retained that 'specific and definable matters must be alleged and that there should be no power to intervene until those allegations have been adequately proved'. Courts in their nature exercise the ultimate sanction of coercion, and it is right that the use of this power should be hedged round with safeguards.

Comparatively few juvenile court cases are really in doubt or involve complicated legal points. The most difficult task of the court therefore normally begins after the case has been found proved. It is at this point that the enquiry into causation commences, with a view to deciding upon appropriate treatment. In comparatively minor cases the 'tariff system' may be appropriate, and a fine or order for restitution may bring home to a boy or girl the need to make good damaged or stolen property. However, it is essential that in every case the court itself should know 'what it is doing and why'. This depends upon its objectives, and since in juvenile courts these must be related to the welfare of the child, they face the problem that '. . . where the court is seeking to reform, to deter or to protect, it is seeking to control future events rather than simply to pass judgment on past events' (Streatfeild Committee, 1961). To control future events by positive, rather than negative means necessitates introducing into the situation some element which will change behaviour, either through the influence of relationship or else by some environmental modifications or by treatment for some physical or mental condition which is contributing to delinquency or waywardness, or by some combination of these and other means. Thus it is essential that appropriate, accurate and comprehensive information should be available to the juvenile courts, and that the magistrates should be competent to use it intelligently in arriving at their decisions. This is all the more necessary when it is remembered that these decisions may alter the course of a boy's or girl's life, and thus are as potent to damage as to reform.

The extent to which these conditions relating to sufficient and well-used information are fulfilled varies considerably, not only from court to court but also because of differences in the adequacy of the supporting services available to the courts. It must always be remembered that the courts do not function in isolation from the social services; indeed in certain aspects their constructive purposes have the same aim as these services.

The information available to the court in arriving at its decision is a school report (where appropriate), a social enquiry report by a probation officer (sometimes from the children's department) and any other report which the court thinks desirable, for example a psychiatric or general medical report or an observation report from a remand home. It is the general practice of city courts to remand or adjourn the case if further enquiries are needed, but in country districts where sittings are infrequent, pre-trial enquiries and a decision on the same day as the hearing may be inevitable. Remands may be either on bail (or in non-criminal cases an adjournment, which does not require bail) or in custody Offenders must not be remanded in custody as a punishment (though in fact this is how it often appears to them) but only if they might fail to appear, or commit a further offence, or for purposes of observation. In certain circumstances the boy or girl may be sent to a 'place of safety', which is usually a local authority children's home or reception centre. There is of course considerable variation in the facilities for obtaining psychiatric diagnostic reports, coupled with a general shortage of psychiatrists skilled in forensic psychiatry. Yet such reports, together with the probation officer's social enquiries, are vital to adequate diagnosis and prognosis in more complex cases. And it should be remembered that a high proportion of the most disturbed and damaged children in the country find their way to the juvenile courts by one route or another. Reports by clinical psychologists are extremely valuable, and also reports by remand home and other staff if these are skilled in observing children objectively and in recording and assessing their findings.

The information made available to the court should be focused upon contributory causes of the delinquent act, neglect, antisocial behaviour or school truancy in the individual case. It should include any record of previous offences, truancy and the like, and the outcome of the treatment ordered by the court; the boy's or girl's school or work record, attitude to school and work, and leisure-time interests; it should give relevant information about his or her physical health, intelligence and emotional development. It should deal with the material circumstances of the home; and above all it must be concerned with the constitution of the family group, the relationships between its members, what other kinship ties there may be, what are the relevant characteristics of the immediate social milieu (for example, whether it is a high delinquency area) and what capacities the boy or girl has for forming friendships with peer groups. This will be the evidence on which to base an assessment of the individual's personality development and degree of emotional maturity in relation to his age; his attitude to the circumstances which led up to the court appearance; the strengths and weaknesses in him and his family and social situation; ways in which strengths might be reinforced and tensions lessened; and a forecast of his probable response to one or other of the appropriate treatment methods available to the court.

It must be remembered that in spite of much research and a flood of contradictory opinions, little is known about the causes of juvenile delinquency. Multiple causation seems obvious. Disturbed family relationships, character disorders, low frustration tolerance, and social pressures which predispose to delinquent sub-cultures, are all known to play a major part. The early detection, control, management and treatment of such conditions still eludes us. Thus the juvenile court magistrates may be taking stock of the information available to them about a particular child or youth at a point where his development has been severely damaged. Fortunately in regard to many who appear before the courts it is possible to intervene in ways which contribute sufficiently to the child's socialisation or re-establishment or family rehabilitation. But at the other extreme, magistrates, probation officers and approved school and borstal staffs must try to effect changed attitudes and behaviour in many whom psychiatrists would write off as untreatable. The inadequate, the aggressive, the immature, and those who know they are unwanted by anyone—and act accordingly—present us with problems that we have neither the knowledge, nor the love to solve. For, in Margery Fry's immortal phrase, 'You can't give children love by Act of Parliament'.

Probably most magistrates develop, consciously or sub-consciously, some guides within which to assess the information available to them, and make their decisions in the light of these. Their estimate of the degree of culpability of the offender or of parents plays its part in this. Nowadays the emphasis is upon maintaining and strengthening family relationships wherever possible, and trying to stabilise young people in their own environment insofar as this is consistent with the protection of the community. Many magistrates are also aware that it is not necessary to use a sledge-hammer to crack a nut, nor effective to try to move mountains with nut-crackers. And they know that merely to punish for an offence rather than trying to deal with the causes is as incompetent as it would be to use the cane to cure chickenpox. It should also be remembered that juvenile delinquents are not necessarily any more homogenous as a group than youthful sufferers from chickenpox.

Reports may be received in writing (after the case has been found proved), but the court must tell the child and his parents the substance of any part of a report bearing upon their character, conduct and home surroundings if the court think this will materially affect its decision. Different courts interpret this requirement differently. In some the chairman reads out the whole report. This is not generally thought desirable, and in others the rule is interpreted more liberally. The most satisfactory procedure is undoubtedly for the chairman to summarise the report, leaving out matters like illegitimacy of which the child may not be aware, and changing the wording of other distressful material. For example, to say, 'This report tells us that your husband is away from home at present' will be quite clearly understood by the other parent to mean the court knows he is in prison, and no confidence will have been betrayed.

It is extremely important to try to secure the co-operation of the child and his parents at this stage, when plans are being made for the future with a view to saving him from the need for further court appearances. Many parents and children show their fear, confusion and shame by aggressive or other unco-operative behaviour. This makes it all the more essential for the court proceedings to be conducted with courtesy and respect for them and for time to be taken to explain slowly in simple language, several times if need be, what is happening and why their co-operation is needed in order to try to put right the situation of delinquency, misbehaviour or need for protection which has brought the case to court. This approach is the quickest means of enabling them to think more objectively rather than to make blanket excuses: moreover, to treat parents as though they basically desired to be good parents often makes it easier for them to behave as though they were. Nonetheless the court faces no easy task in trying to get across to the child and his parents that it is the offence not the offender which the court disowns; that the offences have got to stop; and that a greater degree of responsibility is expected from offenders.

Special difficulties often arise where several children are involved in the same offence, yet enquiries reveal that their circumstances are quite different and that for their welfare they should be treated differently. Here too the court must if possible try to involve children and parents in these different decisions in order to avoid feelings of injustice or discrimination.

The following are the various decisions available to the juvenile courts:

1. *Absolute discharge* (criminal offences only). This means that the court takes no action. This is often sufficient in cases of minor offences by children whose parents are able to look after them.

2. *Conditional discharge* (criminal offences only). If the offender is found guilty of an offence by any court within the ensuing year he is liable to be brought back

to the first court and dealt with in any way that would have been possible for the original offence. This is a useful provision where it is desirable to allow the offender an opportunity to prove that he is able to keep out of trouble.

3. *Fines, costs and compensation* (criminal offences only). Children under fourteen may not be required to pay more than £10 in fines or costs, and fines or costs must be paid by the parent if the child does not do so. Young people may be ordered to pay varying fines up to £50. The court may also impose an order for compensation. Costs or compensation may be combined with an absolute or conditional discharge or a probation order. Payment of costs or compensation to the person who has suffered directly as a result of an offence, for example, where another boy's bicycle has been stolen and damaged, is usually regarded by the offender as just if not pleasant.

4. *Order the parent to give security for the good behaviour of his child* (criminal cases) or order the parent to enter into a recognisance to exercise proper care and guardianship (non-criminal cases). This means that the parent is bound over in a certain sum and that the recognisance may be estreated in whole or in part if the child breaks the law again or if there is a failure to take proper care of him.

5. *Probation Orders* (supervision orders in non-criminal cases). A child or young person may be put on probation for from one to three years to a probation officer of the court where he lives (or will be living). There are certain more or less standard conditions in a probation order, for example, not to commit a further offence, to report regularly, to 'lead an industrious life', not to associate with bad companions, to notify any change of address, and to be of good behaviour. The court may add specific conditions in particular cases. The consent of offenders over fourteen is required to the making of an order. This means that a careful explanation of probation and its conditions is necessary so that consent may include some understanding of responsibility for taking probation seriously. A probationer may be brought back to the court for a breach of any of the requirements in the order. A breach is in itself an offence and if it is proved the offender may either be dealt with for the breach or for the original offence in any of the ways open to the court. The probation order may be allowed to continue, be extended, be discharged, or be automatically terminated, for example by a fine or an approved school order.

Supervision orders (non-criminal cases) do not of course have all the same sanctions as probation orders, though they appear very much the same to the child. Anyone who is not responding to supervision may be 'brought back to be further dealt with after supervision', and the order may be extended, a fit person order made (see No. 8 below) or the boy or girl be committed to an approved school. Those who need some additional support, for example a condition of residence, may be brought back on a summons to vary the order.

Probation or supervision exercised by a trained and experienced probation officer with the right personality is the most effective treatment in the child's own environment available to the court. Its effectiveness is sometimes increased where it can be combined with psychiatric consultation or treatment. Although the focus is on the child, most probation officers would agree that with juveniles they are in fact doing family casework. It is generally recognised that 'The value of probationary supervision—and frequently, therefore, the success or failure of probation—depends primarily on the nature and quality of the personal relationship established between the probation officer and the offender. The type of personal relationship varies very considerably according to the basic motivation and attitudes of the probation officer, and according to the skill and insight with which the relationship is used for specific purposes . . . the relationship may be primarily a professional one in which the officer consciously uses inter-personal relationships to achieve well-defined professional objectives, *viz*. the social rehabilitation of the offender.' (United Nations, 1951.) This description is generally valid, though it fails to take account of the difficulties probation or supervision encounters with those who are not conscious of any problem in themselves with which they need help, or who have a defective conscience or a conscience developed around antisocial values, or who have been too deeply deprived to be able to make personal relationships or plan their lives constructively.

6. *Attendance Centre Orders*. Boys over the age of ten who have been found guilty of an offence punishable in an adult by imprisonment may be ordered to go to an attendance centre from 12 to 24 hours (one to three hours on any one occasion). These attendance centres, which are usually run by the police, are in session on Saturday mornings or afternoons and are only available in certain populous areas. Offenders who do not attend regularly and punctually or who break the rules may be brought back to the court and dealt with for the original offence. The aim is punishment through loss of leisure, and the régime of physical training, handicrafts, writing and other instruction is carried out under strict discipline. Follow-up studies indicate that the results are only effective 'when applied to a young offender with little or no previous experience of crime, coming from a fairly normal background' (Cambridge Inst. Criminology, 1961).

All the foregoing decisions leave the child in his own environment. The next group deals with removal, for short or long periods, from home. This is only considered desirable if the home is grossly inadequate or the environment such that delinquency or 'moral danger' cannot be controlled.

7. *Conditions of residence*. A condition may be inserted in a probation order (or a requirement in a supervision order) that the boy or girl shall reside with some given person, for example, a suitable relative or friend, or in lodgings.

These conditions also apply to various types of institution, including Approved Hostels for those over school-leaving age. These are hostels provided under voluntary auspices but financed from public funds. They are quite small and the boys or girls in them go out to work. The usual length of stay is twelve months (a condition of residence may not be made for longer than this, it is subject to review and may be terminated earlier for good progress). After leaving, the boy or girl usually goes home or into lodgings. There is a great shortage of such hostels and of voluntary hostels associated with them, particularly for boys. At present the majority of approved hostels are in big industrial centres, but a number of new ones are being provided and most of these will be in medium sized towns, which are thought to be more suitable, particularly for offenders from rural areas.

Boys or girls may also be required to reside for a similar period in *Approved Training Homes* which cater for 20 to 35 young people and give training inside the home in farming, gardening, woodwork or domestic work. These probation training homes carry much less stigma than an approved school and are intended to give a short training in a homely atmosphere to boys and girls who are not at the outset capable of going out to work but who do not require the longer and more disciplined training of an approved school. If they make satisfactory progress they may be able to go out to ordinary daily employment from some of the homes during the last few months of their stay. Unfortunately the approved probation hostels and homes face considerable difficulties of staffing, and also arranging a satisfactory programme for the small numbers for which they provide.

Where a condition of residence requires anyone to reside outside the district where he lives, he will be under the supervision of a local probation officer and his family will be visited by a probation officer of the court where the case was heard.

8. *Fit Person Orders.* Offenders who have committed an offence punishable in an adult by imprisonment, and also care, protection or control and school attendance cases may be committed by the court to a 'fit person willing to have the care of him'. This may be a friend or relation or a voluntary organisation, but it usually means the local authority children's department. These orders do not extinguish parental rights (in our law this is only possible under an adoption order). It does, however, give the fit person a prior right of custody and temporarily the rights and duties of the parents. A local authority may only refuse to accept a child on a fit person order if the court proposes to combine this with a probation or supervision order and the local authority does not agree. The consent of a private person or organisation is of course required to an order. A probation or supervision order would almost invariably be made in these cases.

An application may be made at any time to revoke a fit person order. The decision whether or not to do so rests with the court. If it is revoked, a supervision order may be substituted. Any order which is not revoked automatically comes to an end when the boy or girl is eighteen. In the present shortage of places in boarding schools for educationally sub-normal, maladjusted or handicapped children, fit person orders are sometimes used to fill in the long waiting period or to secure a place more quickly. Since these orders can run for very much longer than any other they are probably most frequently used for infants or young children in need of care, protection or control for whom a substitute home must often be provided. It would be expected that, wherever possible, the children's department would also be working with the family (if any), that the child and his parents would be kept in touch, and that he would be returned 'on trial' for a period before an application to revoke the order.

Any child in the care of a local authority (whether under a fit person order or not) who is refractory may be brought before a juvenile court. The court may either commit him to an approved school, make a fit person order to someone other than the local authority (and combine this with a supervision order) or require his parent or guardian to enter into a recognisance to exercise proper care and guardianship. It may also continue the existing order.

9. *Approved Schools.* A court may commit to an approved school the same range of children for whom fit person orders may be made, though they must (other than in exceptional cases) be over the age of ten.

About 5 per cent of the boys and 60 per cent of the girls committed to approved schools are non-offenders. Wherever a classifying school exists, children (other than Roman Catholics) go there first for a period of careful observation and testing so that they may be sent to the school best suited to their needs. Many magistrates think it would be more logical for this thorough observation study to precede rather than follow the making of a given order, but so far the facilities for such observation are extremely limited, though a start has been made in providing the remand centres envisaged in the Criminal Justice Act, 1948.

Children under the age of twelve-and-a-quarter may be kept at an approved school until fifteen, otherwise the commital is for a maximum of three years or until the age of nineteen, whichever is the shorter period. Every child must be periodically considered for licensing, taking into account progress, general behaviour, response to education and social training, and whether or not the boy or girl can return to his or her own home. Most children spend very much less than the full commital period in a school. When a child leaves the school, aftercare is the responsibility of a probation officer or the children's department. Licensing is for the unexpired portion of the approved school order, and supervision for three years after (or up to the age of twenty-one). The school managers retain parental rights during this period and children on licence or supervision may be recalled to the school. The Home Secretary may discharge an approved school order at any time.

The schools are provided and managed either by voluntary organisations (though financed from public funds) or else by local authority children's departments. They are divided into junior (10 to 13), intermediate (13 to 15) and senior (15 to 17) for boys; and junior (10 to 15), intermediate (14 to 16), and senior (15 to 17) for girls. Nearly all schools are to some extent classified according to the children they try to train and the kind of régime they provide; for example, there are three nautical schools, two schools for boys of high intelligence, and two schools for girls requiring psychiatric treatment. There has been a considerable increase recently in the facilities for psychiatric consultation and treatment at the approved schools.

The schools are intended for children who need a fairly long period of residential training. From some approved schools the children go out to an ordinary day school in the neighbourhood; they also receive vocational training, though the basic aim is the readjustment and social education of the children so that they may be able to live more satisfactorily in the community. The means to achieve this aim are:

> '. . . to base this process of rehabilitation on understanding of the personality, history, abilities and aptitudes of each child, and on knowledge of the family situation; and to promote it by a stable environment in the school enabling remedial influences to be brought to bear and progressive training to be given, by contact with the home, and by help and supervision after the child leaves the school.' (Home Office, 1961.)

Wherever possible, parental visits and correspondence are encouraged, and periodic home leave is given. Under the Criminal Justice Act, 1961, a boy or girl who is seriously unruly or subversive may be removed on a warrant to another approved school or a remand home or remand centre for a period of twenty eight days.

10. *Detention in a Remand Home or Detention Centre.* A child under fourteen who has been found guilty of an offence punishable in an adult by imprisonment may be sent to a remand home as a punishment for up to a month. Boys or girls

over fourteen may be committed to detention centres (where they are available) provided by the Prison Department. They must be physically fit to undergo the brisk training with strict discipline and supervision which the centres are intended to provide. The programme is devised to cover three months, which is the normal period of commital. Under the Criminal Justice Act, 1961, young people released from detention centres are under supervision for a further twelve months, and liable to recall for misbehaviour.

11. *Borstal*. A juvenile court may commit to Quarter Sessions for a decision about a borstal sentence a boy or girl over fifteen convicted of an offence punishable in an adult by imprisonment. If Sessions is satisfied, having regard to his character and previous conduct and the circumstances of his offence, that this is the most appropriate training, and if a report on his physical and mental condition indicates that he is suitable for such training, then it may pass a sentence of Borstal training. Unfortunately these boys and girls may wait in prison for up to twelve weeks until their case comes up at Quarter Sessions. It is largely for this reason that the Ingleby Committee recommended that juvenile courts should have power to impose a borstal sentence. Under the Criminal Justice Act, 1961, they have extended powers to impose a borstal sentence on boys or girls over fifteen misbehaving at an approved school.

Borstal institutions are run by the Prison Department. Young offenders are first sent to classifying centres, and the borstals (some of which are open) are classified according to the type of boy or girl and the training provided. Under the Criminal Justice Act, 1961, the sentence is for two years (with a minimum period of detention of six months) and with a further two years on licence. Borstal after-care is undertaken by probation officers.

12. *Imprisonment*. A juvenile court may not impose a prison sentence, though a higher court can impose such a sentence on anyone over seventeen. It is therefore both illogical and regrettable that a juvenile court may, and often must, remand an offender over fourteen in prison if he or she is so unruly or depraved as to be incapable of being detained in a remand home. More provision of remand centres and closed sections at remand homes and approved schools is urgently required to remedy this anomaly, and strongly recommended by the Ingleby Committee.

13. *Orders under the Mental Health Act, 1959*. Offenders, or boys or girls found to be in need of care, protection or control, may be admitted to hospital or placed under guardianship under the Mental Health Act, 1959. Before making an order for detention in hospital or for guardianship the court must be satisfied on the written or oral evidence of two doctors (one of whom must have special experience in the diagnosis or treatment of mental disorder) that the boy or girl is suffering from mental illness, psychopathic disorder, sub-normality or severe sub-normality, and that the most suitable method of dealing with the case is an order under the Mental Health Act. A hospital order may only be made if the boy or girl can be admitted to a specified hospital within twenty-eight days. It may be combined with a fit person order, which means that the children's department would have an obligation to keep in touch and to be responsible for the boy or girl after discharge from hospital. Under certain circumstances restriction orders, *i.e.* restricting the discharge of the patient except with the consent of the Secretary of State, may be made in relation to offenders over fourteen.

Guardianship orders require the consent of the person or authority to the making of the order. It is too early as yet to tell how these provisions will work out in relation to the small but extremely difficult group of mentally disordered young people who appear before the juvenile courts. Shortage of treatment facilities for children and adolescents in mental hospitals or in special units is a severe problem.

This concludes the range of decisions available to juvenile courts and the kind of diagnostic information they need to arrive at the most appropriate decision in the individual case. It will be abundantly clear from what has been said that these courts cannot function without adequate supporting services. Our limited knowledge of contributory causation of juvenile delinquency, as well as of the relation between any given form of treatment and its outcome, make it all the more necessary to detect and treat incipient delinquency, neglect, maladjustment or waywardness at an early stage. But at present we woefully lack the preventive and therapeutic services which would make this possible.

Postscript

In August, 1965, the Government published a White Paper, "The Child, the Family and the Young Offender", setting out its proposals for reform. The suggested changes are:-

1. To raise the age of criminal responsibility to 16.
2. To institute non-judicial family councils appointed by local children's committees.–These councils would consider cases of children who had committed what would in someone over 16 be an offence or who were in need of care, protection or control or who were not going to school. If the facts were not disputed and the parents and child agreed to the proposed treatment, this would be recorded. If there was dispute about the facts of the case, or about the proposed treatment, or if the family council thought the case should be heard judicially, then it would be remitted to a family court.
3. To set up family courts which would hear cases remitted to them by the family councils. These courts would have wider powers, *e.g.* the imposition of fines, than the family councils. Their decisions would of course be binding.
4. To lower the age of care, protection or control proceedings from the 17th to the 16th birthday.
5. To abolish approved schools. Most junior and intermediate schools would be taken over by the children's departments and become part of a comprehensive range of residential treatment. Fit person orders would be substituted for approved school orders so that there could be much greater flexibility in the treatment of an individual child. Any agreement about treatment could be varied from time to time with the consent of the parents, and in any event the family council would have to review every case at least once a year.
6. To set up young offenders courts. The same panel of magistrates would sit in a family court and the young offenders court. The latter court in passing sentences would be required to have regard to the offender's welfare (at present this only applies to juvenile courts). All the present forms of treatment would be available to the court. Senior approved schools would be taken over by the Prison Department and, together with the present Borstals, would form Youth Training Centres to which boys or girls would go for

9 months to 2 years. 'Separate establishments' (unspecified) would be provided for those needing longer training.

The Government recognises the extreme importance of preventive work and adequate services to underpin the proposed new structure. This means that existing children's and other services should be co-ordinated and enlarged to form a family service. The Government accordingly propose to appoint a small independent committee to review the organisation of the local authority personal social services and to consider what changes are necessary to create an effective family service. There was reference to this proposed Committee in the Queen's Speech (November, 1965) but no definite commitment to introduce legislation on the White Paper in the current parliamentary session.

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Chapter 20

ACCIDENT PREVENTION

THE annual death figure from transport accidents in England and Wales exceeds 6,000, and in Scotland amounts to around 700. Lain (1964) analysing road casualties in 1963 showed that these reached a new peak. Of 356,179 road casualties, 55,500 involved children under fifteen years, representing an increase of 4·1 per cent over the figure for 1962. Of these casualties 809 died and 12,426 were seriously injured. The annual cost to Britain from road accidents alone amounts to some £172 million—more than £3 per head of population. In 1962 more children under fifteen years died from home accidents in Great Britain than in any previous year, no less than 911 under five and 124 between five and fifteen years, these figures representing increases of 14·9 per cent and 11·7 per cent respectively over the figures for 1961. The cost of home accidents also must therefore be considerable.

Over the past twenty years there has been a complete change in the main killing factors. In 1946 the deaths due to infectious disease were twice those due to all accidents, but by 1956 deaths from infectious disease were half those due to accidents and today they are less than one-third. Infant and child mortality has thus shown over this period a steady and, in some instances, a remarkable decrease. The accidental death rate does not, however, permit any cause for satisfaction but rather engenders a feeling of disquiet, since in most developed countries accidents now form the main cause of death in childhood and adolescence.

Accidents to children occur in the homes and on the roads. The steadily increasing standard of living has brought additional new hazards to the home and considerably more traffic on the roads. Not only are the mortality figures rising but also there is a corresponding increase in morbidity, a greater suffering, a greater disablement and disfigurement. The vast majority of these accidents are preventable. The element of human weakness will always exist but the incidence of the many tragedies could be limited by precautionary and preventive measures and by education. The average healthy child is not so much careless as carefree. The public should become aware that accidents kill more than twice as many preschool children as measles, scarlet fever, whooping cough, diphtheria, dysentery, tuberculosis and poliomyelitis combined. The importance of accidents is also very real when applied to a country's economy, an aspect that tends to be forgotten.

In present-day society accidents tend to be accepted and considered as inevitable but there is no justification for this attitude. There should be no legislation at all for ill health. The natural heritage of a child is good health and he should never become the victim of an accident, and this should be our attitude. Every hospital is to some extent a confession of failure—failure to keep children well. Children's hospitals are looked on with pride and the sick child with sympathy.

Beautiful modern new accident services are designed. Instead of doing more to prevent accidents it seems more lavish welcomes are being prepared for the victims. Even capital punishment gets more attention paid to it than the unfortunate innocent child struck by a home or road accident.

Certain measures have been adopted in Britain to reduce the scourge. The Royal Society for the Prevention of Accidents was founded in 1916 to institute widespread educational propaganda related to home and road accidents and was directed towards pedestrians, cyclists, motorists, parents, teachers, road organisations and education and local authorities. The police have played an important part in road safety training of school children and in the development of road sense.

In 1948 a grant from the Home Office enabled the Royal Society for Prevention of Accidents to set up a small Home Safety section. Many local authorities have established similar bodies.

Home safety measures can be grouped as follows (British Medical Association, 1964):

(1) *Governmental:* The Home Secretary in 1947 set up a Standing Interdepartmental Committee on Accidents in the Home.

(2) *National Organisations:* The Royal Society for the Prevention of Accidents gave the lead, but home safety courses are encouraged by the British Red Cross Society, St. John Ambulance Association, St. Andrew's Ambulance Association, Girl Guides' Association, etc.

(3) *Advisory Bodies:* Such organisations give valuable help with technical and educational problems of home safety, *e.g.* nationalised fuel industries, the British Standards Institution, Fire Prevention Officers, and the Central Council for Health Education.

(4) *Local Authorities:* Medical Officers of Health, with their health visitors and home safety officers, carry out much good work in prevention through instruction, publicity displays and evening classes. In some towns fireguards are specially made and offered at a small rental to families with children under the age of seven years.

(5) *Local Voluntary Home Safety Committees:* These committees concentrate on general publicity through lectures, displays, competitions and exhibitions.

The high accident rate in children is an international disgrace. Though reports tend to give little information of accidents in the first year of life, a survey in the Newcastle area of 1,000 children born in the year 1947 showed that 61 children of this age group suffered 66 accidents (Spence *et al.*, 1954) and the follow-up (Miller *et al.*, 1960) recorded 732 accidents in 847 children in five years, which contributed 8.5 per cent of their total illnesses. Rowntree (1950) reported that children under the age of two years had an accident rate of 80 per 1,000. In America figures indicate that children under five years show an accident rate of 207 per 1,000 compared to an over-all rate of 125 (Collins *et al.*, 1953).

Analysis of figures directed to age groups offers valuable information. In children under one year the problem of accidental asphyxiation is characteristic of this period. In addition there are falls from cots or prams, strangulation or suspension from harnesses or between the bars of playpens, suffocation from plastic bibs or pillow, lead poisoning (Moncrieff *et al.*, 1964), from chewing paint off cots or sucking of painted toys, choking from foods or objects sucked, etc.

All accidents are tragic but death from suffocation is one of the most distressing. Though plastic bibs may be the cause, the propped-up feeding bottle should never be employed, and babies should be encouraged to 'break wind' after feeds. Soft deep pillows are dangerous and also small toys in relation to obstruction of the airway.

Many of the dangers in the first year are obvious but preventive measures are inadequately organised and sustained.

In the pre-school age, the child has become very active and keen on exploration, both in the home and outside. Stairways, roads, water, flame, fire, gas, electricity and oil have great attractions, as do bottles of sweets, pills and coloured fluids. Figures vary, but over 35 per cent of all fatal accidents in this group result from motor vehicles. Again, preventive measures seem clear and responsibility must fall on the parents, though more instruction in mothercraft and homecraft would be beneficial.

In the two- to three-year age-group drowning accidents are not uncommon. Among home accidents burns and scalds stand out by their frequency. In the one to two age-groups scalds are common from upsetting of teapots or plates of soup. In the three to four age-group burning injuries are seen from playing with matches or fire or from grasping electrical elements. Burns are more common in girls from their light flammable clothing. Poisoning from pills is also relatively common. With the improvement in social standards there has been a steady increase of washing-wringer injuries.

In the school age-group the incidence of home accidents declines and the traffic mishaps become more frequent, *e.g.* bicycle and motor accidents, falls, etc.

The majority of fatal accidents in children result from motor vehicles, from drowning and from burns or scalds. Morbidity figures are always difficult to assess but there is no doubt of the high morbidity rates following burns and scalds.

A maxim, often quoted, states that if the possibility of an accident exists in any situation, then inevitably, sooner or later, that accident will happen.

The factors concerned in accidents can be grouped: (*a*) existing danger points and (*b*) human or supplementary factors. Both can be applied to road or home accidents.

On the road the dangers will vary according to the volume and nature of traffic and to some extent the age of the child. The child under four should be accompanied, and so protected; the child over four should be educated. The responsibility of training must in part remain in the first place with parents and later to some extent with local authorities, the police and education authorities. In relation to car drivers, they must observe speed regulations, take special care in built-up areas and in the precincts of schools and children's playgrounds, and employ all manner of safety devices in cars. In respect of young cyclists, training and development of road sense is an absolute necessity.

The main danger points in roads are, of course, busy crossings, blind corners and main roads abutting on to schools. Such danger points are the responsibility of corporation or county authorities.

The dangers in the home are many and are best considered in relation to the separate rooms. A child is in greatest danger in the kitchen, the centre of a mother's activities. The possible dangers are many, open fires, gas or electric cookers, hot liquids in pots, pans or pails, washing machines, paraffin heaters, electric points and gas switches, matches, etc. Again, if meals are served in the kitchen there are the additional dangers of hot soups, hot tea or coffee, etc. In the bathroom there are the electrical dangers, the dangers of bottles of pills or medicines, the dangers of razor blades and the danger of too hot water in the bath. In the bedrooms there are dangers from portable electric fires and from electric blankets and hot-water bottles. A very real and common danger is the flammable nightdress. Specially related to young children are the bath, the chamber-pot and painted (lead) or sharp-pointed or flammable toys or toys with small buttons.

Common customs are the heating of the bath and the chamber-pot with water that is almost boiling. The dangers of this unfortunate procedure are obvious.

There are of course dangers common to all rooms, faulty switches, torn carpets, and open fires with absent or inadequate fire-guards.

Mention has been made of human and supplementary factors. The most important is the harassed mother. The busy mother should endeavour to work by a safety time-table. She should place her young child in a play-pen or in a pram with a safe harness when she is most busy. Before a busy spell starts she should check on all fire-guards. In respect to staircases and open windows, the best protection is some form of gate or guard.

In general, the answers to many of the dangers are clear. All fires, no matter their type, should have an adequate guard which should always be in position and be fixed and never used for drying clothes.

A play-pen should be kept folded up in readiness for use and the spars must be close enough to prevent the baby's head slipping between. Harnesses, if employed, must be carefully applied. Young children under two years should not sit at table but be put in a high chair, a little distance from table.

Accidental poisoning from pills is a very real danger and many pills are impossible to distinguish from sweets. Figures indicate that ferrous sulphate, antihistamines and aspirin are the commonest agents. In most instances the careless placing of medicine bottles is the primary cause, but the practitioner also cannot be exempted from fault. Other commonly ingested poisons include disinfectants, barbiturates, kerosene and camphor linaments (Craig and Fraser, 1953).

Flammable clothing, *e.g.* cotton, flannelette and winceyette, is one of the main dangers, and although the Consumer Protection Act, 1961 (see Appendix) prohibits the sale of dangerous ready-made children's nightdresses, it does not restrict the sale of flammable materials from which these can be made. The time is surely ripe for an international demand for the production of non-flammable clothing. Parents should be encouraged to choose the newer safer fabrics for their children. In this respect also this form of burning injury would be considerably reduced if the Heating Appliances (Fire-guards) Act, 1952, was observed. This Act clearly states that the sale is prohibited under penalty, of electric, gas- and oil-burning fires unless fitted with a guard complying with prescribed standards. It is important to note the act does not deal with the open fire.

To meet the human factor consideration must be given to education in mothercraft for girls and homecraft for boys. The public must become accident-conscious. The National Health Service could give a lead by the establishment of a Prevention Section and in universities 'Preventive Medicine' should include

'Accident Prevention'. Propaganda by posters, pamphlets, films and talks can play an important role. The family doctor, however, by personal advice and guidance is in many ways the key figure and he must recognise and face his responsibilities.

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Chapter 21

HEALTH EDUCATION

For no group is health education more needed than for children and those who influence them. Consider for example the relationship between certain habits and certain disorders: unhygienic habits associated with the spread of infection; promiscuity with illegitimacy and venereal disease; smoking with lung cancer; excessive eating with obesity and a higher death rate from various causes; insufficient exercise with coronary thrombosis; excessive drinking with alcoholism; sustained worry or resentment with psychosomatic disorders.

Clearly certain learned attitudes and habits induce disease. But they will not be stopped to order. If a child fails to acquire harmful habits it will be because of his nature and upbringing; if having acquired them he discards them, it will not be because we forbid them or advise against them but because he himself rejects them.

So, if we are to influence for the better the attitudes and practices formed in childhood, superficial propaganda will not suffice. To medical knowledge we must add educational insight and skills. We must know something of how people learn and how they can be led to change existing habits.

Yet educational means must be subordinate to health ends. We must answer the questions 'Towards what end?', and 'What should be taught?' before we ask 'How?', 'When?' and 'Where?'.

Towards What End?

We are concerned with education about disease only so far as knowledge of its causes and treatment will promote health. We are not trying to produce a race of 'home doctors'. Our aim is to encourage people of all ages to form attitudes and habits that will help them to become as healthy and happy as their nature and circumstances permit. A corollary aim is to make them want to do what they can to safeguard the health and happiness of others.

We shall not attain these complex goals merely by telling people what we know, and what we think they should do. We must also transmit insights, attitudes and skills. We must inspire as well as interest, enlighten as well as inform, show as well as tell. People must be encouraged to think, argue and experiment as well as to listen, watch and copy. We shall succeed to the extent we make health education a sharing rather than just a giving and receiving, and healthy living an almost instinctive way of life rather than a fear-ridden obsession.

What Should be Taught?

At first a child need only be schooled in healthy tastes and ways until they become second nature. But as he grows older health knowledge should gradually be added to healthy habits.

Anatomy and Physiology. Knowledge of how the human body is made and how it works should be built up throughout the later years of childhood. It should be detailed enough to provide a rational basis for advice on diet, exercise, sleep, excretion, ventilation, clothing, heating, lighting and other matters of hygiene. The physiology and hygiene of the reproductive system should be discussed in the same way as those of the respiratory, digestive, circulatory, excretory, nervous and endocrine systems, and the special senses. At every stage, children should be encouraged to study the relation of man to his environment. In schools, this study should be closely integrated with physical education, and with instruction in biology, homecraft and domestic and social science.

Biology of Infection. Human ignorance and carelessness contribute largely to the spread of infection. Health education must therefore include systematic instruction in the biology of infection. An occasional film or lecture, the periodic distribution of leaflets, and the display of posters giving didactic advice are not enough. All those who are capable of understanding them should have a good grasp of the nature and needs of micro-organisms, the sources of infection, the means of spread and what can be done to block them. The more intelligent children should also learn about the factors favouring bacterial multiplication, the nature of the body's reactions to infection, the means by which resistance to infection can be raised, and how the body can be assisted to recover when infection actually occurs. Those who are in key positions, *e.g.* food-handlers, should receive in addition specific instruction in what they must do to protect others, and why.

Accident Prevention. Each year, accidents cause over 20,000 deaths in England and Wales, and several times that number of permanent disabilities. Children should therefore be told about the causes of accidents and how they can be prevented. This need not be done in such a way as to create over-fearfulness. Our aim must be to show children where the dangers lie and how they can be reduced or avoided. In some areas, police give playground demonstrations of test-situations for pedestrians and cyclists, illustrating the highway code and means of accident prevention. Schools should deal similarly with home accidents.

Individual and Social Psychology. When it comes to social skills and understanding and control of the emotions, we are on more delicate ground. There is a danger of causing self-consciousness, excessive introspection and loss of natural style. Clearly, there is a need here for mature and well-trained teachers, who can educate in these matters with insight and restraint, and by example and sympathetic discussion rather than by formal teaching. But surely our schools fail if they do not inculcate the attitudes and skills needed for happy and mutually satisfying personal relationships at work, in social and family life and with the opposite sex. And surely their scale of values is faulty if this does not rank high—indeed take first place—amongst the objectives. Some of the ways by which these objectives might be attained are touched upon in later paragraphs.

Rules of Hygiene. In the home and nursery school the young child should be drilled in health practices until they become second nature. But as he matures he should be encouraged to seek for the reasons behind these practices and to change them if he finds cause to do so. This examination will best begin with actual problems or as a natural development of studies of physiology, psychology, and the biology of infection. Indeed, if these have been well taught older children and adults should be able to work out the rules of hygiene for themselves. Rules discovered in this insightful way will mean much more than those merely learned by rote. The implications of these basic studies for daily living should be considered at every appropriate opportunity. The nature and consequences of over-indulgence and addiction should be examined and discussed, so that then each can, with reasonable knowledge of the facts, decide for himself what his practice will be. Continual attention should be paid to how one's own hygienic practices—or malpractices—can affect the health of others.

SEX EDUCATION. No child can grow up without learning something about sex and forming attitudes towards it. So the question is not whether children should be sex-educated or not, but how far they should be systematically educated, and when and by whom.

Now that society ordinarily protects us from excessive hunger, fatigue, discomfort, and physical danger, the sex urge is left without seriously competing primary drives. Indeed it is reinforced by the primary drives of curiosity and the need to be active. Its control therefore depends upon acquired secondary drives. But here society is inconsistent: on the one hand, it calls for suppression until marriage at an average age of twenty-six for a male and twenty-three for a female; on the other, it uses every device of publicity, entertainment, and adornment to titillate and inflame. Under these circumstances it is unwise to perpetuate ignorance and to leave each generation to solve its problems without the help that knowledge and discussion can give.

ond. / Our concern should not be just with control: direction is equally important. Our aim should be to help the child so to grow up that for him sex will be not damaging, but enriching. To do this we must answer his questions straightforwardly. We must avoid giving him a false sense of shame about his body and its functions. We must teach him the anatomy and physiology of sex as an integral part of education concerning the general structure and function of the body. We must instruct him in the nature of venereal disease as part of his study of infection. And, as he matures, we must balance his knowledge of the physical with a critical appreciation of the emotional, social and moral aspects of sex. In parallel, we must develop his self-respect, his integrity and power of control from within, his inclination to balance distant consequences against immediate satisfactions, and his readiness to consider and respect the rights and well-being of others as well as of himself. We must help him to think of sex relations as a form of human relations requiring the highest standards of emotional honesty and consideration for others. If we succeed, he should come to regard sex as a natural and enriching activity, and the sex drive as an additional power to be developed and fulfilled like all the others, but one that, because of its strength, especially needs to be self-controlled and wisely directed. These aims should be systematically pursued at home and in school, formally and informally.

PREPARATION FOR MARRIAGE. The relationship of husband and wife is second in importance only to that of parent and child. So, during adolescence, both sexes should be encouraged to consider the purpose of marriage, what it gives, and what must be put into it. They must be helped to realise that it is a complex relationship involving much more than the romantic and the sexual. When they become engaged they should together attend a formal course of instruction to discuss and prepare themselves for their new relationship and the adjustments, responsibilities and duties it will involve. Help in preparation for marriage, and in facing marriage difficulties, can be obtained through the various centres sponsored by the Marriage Guidance Council.

PREPARATION FOR PARENTHOOD AND FAMILY LIFE. Since the early years of childhood are the most formative, parents and home are the most important influences in a child's life. Education for parenthood and family life is therefore an essential, but so far largely neglected, part of education. No one should complete his formal education without adding to his knowledge of physiology and psychology a broad understanding of the special needs of young children. In all maternity and child welfare schemes provision should be made for systematic as well as opportunist education of future or actual parents. Although a father's influence is not so great as a mother's, his part in shaping the home atmosphere and in training the child must not be forgotten or underrated.

THE EFFECTS OF ENVIRONMENT. Environmental factors affecting health must be modified principally by social action. Older children should therefore be taught how the physical and cultural influences at work upon the community affect health. Grammar school sixth formers should be capable of understanding and discussing vital statistics in their broad forms. By correlating what they have learned of physiology and social psychology with what they learn about environment and its effects, they should be able to assess more objectively the importance and the goodness and badness of physical and cultural factors. The better political judgement and sense of responsibility that would result must surely hasten social action to remove harmful influences and replace them by good.

Commercial advertising should be one of the forces considered during this course of social studies. Pains should be taken to develop the older children's capacity to assess the true value of the claims made for patent foods, vitamin preparations, patent medicines, alcohol, and tobacco. This examination will be based, of course, upon the studies already discussed; but it should also include a study of the psychology and ethics of advertising in all its forms.

SOCIAL AND HEALTH SERVICES. Many social and health services are on a wholesale scale. In a sense they impose good conditions upon the individual without requiring his co-operation, and indeed often without his knowledge. To be really effective, however, an increasing number of them must be known to the citizen, and wisely used by him. It follows that the older child should know about the social and health services provided by his community, what their purpose is, where to find them, and how to use them. No new social or health service should be introduced without a systematic attempt to see that those for whose use it was designed know its purpose and its arrangements. Educational measures of this kind will help to ensure that existing services are wisely used and that needed services are introduced.

Principles

Clearly health education is more than a set of health rules to be learned by rote. It must inform as well as instruct, and persuade as well as inform. Attitudes and behaviour must be changed as well as knowledge.

One learns by noticing something (*observation*), by finding or being given the facts (*information*), by being told what to do (*instruction*), by copying a model (*imitation*), by being shown how (*demonstration*), by experimenting with possible alternatives until one is found that works (*trial and error*), or by constructive reasoning (*insight*).

Learning may be incidental or motivated. It is incidental when it occurs in the course of activity that is aimless or motivated by some unrelated drive. It is motivated where one wants or fears or dislikes something (*motive*), notices something that suggests that action is needed (*cue*), does domething (*response*), and as a result gets what one wants or escapes from something one dislikes or fears (*reward*). Health educationists must therefore be aware of the roles and interactions of *motive*, *cue*, *response*, and *reward* in the process of learning.

Motive. To bring about changes in the attitudes and behaviour of those he seeks to influence, the health educationist must know to which relevant motives he can appeal.

The infant can be educated through an appeal to his need for food, drink, knowledge, activity and freedom from pain and fatigue. And these, of course, remain basic drives throughout life. Indeed, the secondary drives are refinements and extensions of them. But these growing refinements, and the welling up of the great primary drive of sex, steadily widen and increase the motives to which we can appeal. To the primary drives towards relief from physical tensions, the child quickly adds a longing for love and approval, first of his mother, later of his family and his group. His instinctive drives are also modified by the growth of conscience and of will. He develops, too, a need for mastery and success. At first these secondary needs express themselves physically, but they soon overflow into intellectual, emotional and social fields. He wants to be grown up: to be loved and cared for certainly, but also to be successful, admired and respected. It is to these motives that we must appeal in young children: to their desire to do the grown-up thing and to know how things happen and why. At this stage we must be content with teaching the grosser skills of healthy living.

With older, but still pre-pubescent children, these motives remain but mature into more refined and purposive channels. These older children are no longer content with a mere skeleton of factual knowledge and with gross skills. This is therefore the time when we can demand perfected forms of health practices and feed a store of health knowledge that will be a valuable foundation for later more advanced studies.

During adolescence the striking endocrine and maturational changes that appear at puberty (Chapter 7) express themselves in ways of great importance to health education. The pre-pubescent child had mastered the basic skills and moved confidently about a familiar social environment. But the adolescent finds himself in a new and disturbing world with a new and disturbing self. He is aware of changes not only in his body but in his mind.

These changes, and the questing and aspiring self-consciousness they bring, drive him towards self-improvement, self-government and the acquisition of knowledge and skills. Adolescence is therefore a fruitful period for health education. Appealing to the youth's self-conscious desire for health, strength, agility and poise (or the young girl's longing for health, beauty, style and grace), we can start with a study of the body, its development and care, and its use and abuse. But we can then lead the adolescent to consider the influence of mind on body, and to seek to develop grace and skill in human relations as well as beauty in physical form and movement. And by way of a skilfully developed series of interests, these unspoken longings and the adolescent's growing interest in sex can help him to find better goals and ways of life. To his existing knowledge of structure and function we can thus add consideration of relations and of purpose, so developing the social and philosophic aspects of health education.

As the adolescent enters adult life he normally falls in love in a way that blends romantic and sensual elements and turns his thoughts to marriage and family. The young adult is therefore keenly interested in the physical, emotional, and social adjustments of courtship and marriage. As a corollary, he becomes more concerned with the socio-economic structure and with such services as housing and health. He is therefore ready to learn how to play his part in seeing that the community provides the conditions necessary for health.

Communication cues. Not only must the health educationist know to which motives he can appeal, he must also know how to use educational cues that arrest attention, promise reward, and teach how to respond. Science is rapidly extending the means of communication, and our understanding of how they should be used. Indeed the art of choosing, blending, and handling them is itself becoming a science. Effective health education therefore depends upon the study of what is known of the science of communication, and the disciplined practice of the art. Good will and intuition are not enough.

No matter what its form, to be entirely successful a communication must pass several tests. It must arrest attention: otherwise it will not even be observed. Having arrested attention, it must hold it long enough for its message to be grasped. To hold attention, it must be significant to the person concerned. To be significant, it must be related to his circumstances, his experience, or his hopes or fears; it must appeal to one or more of his drives; and it must suggest the possibility of reward or of escape from unpleasantness, preferably soon. To maintain its significance it must build on existing interests and develop step by step new interests, new desires, or new promises of benefit until its final point has been made. For its message to be grasped and its final point made, it must be intelligible. To be intelligible it must be adjusted to the intelligence, knowledge, and experience of the person or group addressed. To be effective it must be acceptable. To be worth-while, it must modify attitude or change behaviour.

If the intention is merely to prepare the way for later, more specific cues, a communication need do no more than create a new, or stir up an existing, feeling. But if it is meant also to modify behaviour, it must give a reasonably clear indication of what response should be made, and how. It does this best if it demonstrates as well as tells. To be translated into action it must be practicable. And it will be fully effective only if it brings about the response that is wanted—if it taps the wells of motive and directs the released stream of energy into the desired channel.

Ideally, therefore, a communication should inspire to action as well as indicate what the action should be. A completely adequate communication is a *signal*, a *model*, and a *spur*.

A single instrument of health education can seldom satisy all these criteria. Fortunately, in learning, as in physiology, there is summation of impulse. Stimuli which by themselves would be ineffective may in series lead to action. And in this series the early communication that does no more than create or maintain an interest, or the intermediate one that modifies attitude, plays as essential a part as does the final, trigger stimulus that changes behaviour.

Health education should be continuous and varied. No matter what the topic may be, or what the desired response, we should as far as possible present the communication in all its effective forms, use all available media, involve as many senses as we can, and appeal to every motive that is not itself damaging. But discussion of the relative value of different approaches and different media of health education is by no means mere pedantry. An approach or a method that is acceptable and effective at one age, or in one social, economic or educational circle, may make little or no impression earlier or later, or in other strata of society. Even in the same age group or social group there are wide individual differences in the capacity to understand and to be stimulated by a given communication.

It is probably safe, however, to make a few generalisations. For most people, doing is better than seeing, and seeing better than hearing. Best of all is repeatedly to see and listen to a demonstration by an admired or trusted model, copy it, compare one's imitation with it, and see and be told how near one is to an exact match.

Media vary too in their prestige value, independently of the message conveyed. In all likelihood a newspaper article carries more weight than an advertisement, a leader more than an article, *The Times* more than a local weekly, the radio more than the press and direct face-to-face contact more than any other medium. The status of a poster is probably related to its size. A leaflet shares some of the authority of the organisation that produced it. The same can probably be said of an exhibition or a film.

In health education by personal contact, influence depends to a great extent upon recognised superior knowledge or skill, and evidence of disinterestedness. Status in this sense is greatest in the sphere in which it was won. Accordingly doctors, dentists, psychologists and nurses have great influence in health education, just as champion athletes have in sport. Nevertheless, there is an overflow of prestige into all related and many unrelated fields. This means that an athlete, a film star or a 'pop' star can have great influence for good or bad.

Parental example and instruction are of dominating importance. Parents are first on the scene; their influence is for some time undiluted; they control the rewards most vital to physical and emotional well-being and security; they are loving and loved; contact with them is continuous and intimate; and they can demonstrate and correct as well as instruct.

The influence of teachers is also comparatively early and substantial. So health education in school is of great significance since through it all children could be continuously and systematically health educated over a period of years by people whose authority overflows into the field of health.

The health educationist must therefore do all he can to enlist the support of such people. Although he will use as many visual and aural aids as he can, he should direct his greatest efforts towards interesting and educating the natural health educators—parents, teachers, youth leaders, social workers, nurses, doctors. Other means of communication are merely aids.

Perception. A major difficulty in communication is that the same thing is differently perceived by different people. We tend to see what we expect, hope, or fear to see. Gross examples of how the same thing is perceived differently by people with different values and experience are: personal cleanliness, diet, sexual morality. If people have the same backgrounds, knowledge and expectations, communication is easy; if they have not, it is difficult. Indeed, it may even be impossible until the barrier of different perceptions of the same thing is recognised and removed.

Health educationists who are not aware of this mechanism may fail at this point. They may seek to communicate something that they perceive to be obvious. But for those with whom they are trying to communicate this may be only one piece of a complicated jigsaw from which many pieces are missing, or they may relate it to an entirely different pattern.

There is still greater risk of misunderstanding when people of one culture or sub-culture try to communicate with those of another. Sometimes this is simply because they have entirely different backgrounds of knowledge, experience, circumstances and resources. Often it is because the practices it is desired to change mirror a philosophy of the nature of disease that is opposed to the concepts of modern medicine. Or it may be because the recommended measures offend against traditional beliefs.

Such philosophies and traditions cannot be attacked without giving rise to anxiety or hostility. The health educator who is unaware of them, or who knowingly flouts them, will inevitably meet resistance. For example: blood-testing may be refused because an enemy could use the blood to make an evil charm through which he could injure (Afghanistan). Hospitals may be boycotted by pregnant women because they do not permit a ritualistic ceremony on the third day after birth (Viet Nam), or prevent ritualistic disposal of the placenta (Latin America), or prohibit the traditionally prescribed diet (Latin America), or make it impossible for the newborn baby to be laid naked on the soil of his ancestors (Africa), or because they are too well aired, and fresh air is bad for a woman in childbirth (Ecuador). An operation involving amputation may be refused because it would mean being without the amputated part throughout eternity (China). A man may decline to go to bed even when seriously ill because to do so would be unmanly (Greece). Better lighting and ventilation may be resisted because it would give the 'evil eye' more chance to cause poverty, illness and death (Uganda). Water from newly bored wells may not be used because the village geomancer had not been consulted to ensure that it was not bored into a vein of the dragon that sleeps under the soil of the village (Viet Nam). Insect vectors of disease cannot be killed because all life is sacred (certain Buddhist countries). Health clinics may not be used because they have been built on the site of a tomb; or because the doors face in the direction from which the evil spirits come and no protective screen has been put up (Viet Nam).

It is on such magical or religious beliefs that resistance will often be based; just as it is upon our 'scientific' beliefs that we found our health education. The clash of 'faiths' leads to stalemate. So in his own, as well as in foreign cultures, the health educator should acquaint himself with relevant folk beliefs and customs. He should assess which favour and which oppose the desired change of attitudes or practices. He can then use those that are consonant with his goals. And he can help people to see antagonistic traditions and customs in a new light while showing them that he respects their right to decide such things for themselves. With these preliminaries he will be less likely to offend and more likely to persuade.

It is precisely because of these differences in perception that participating methods of health education are superior to didactic. Properly handled, personal or group discussions bring differences of perception to light. Those involved can then seek common ground from which they can together advance to examine facts in an immediately related field. Once agreement has been reached there, they can again move forward step by step.

Reward. In health education our aim must often be to get people to change existing habits. They will be most likely to do this if the existing habit no longer pays and the desired response is well rewarded.

Ordinarily, the reward offered by the health educationist will be a positive satisfaction. But this is not always possible. Immunisation against poliomyelitis is a case in point. It has no direct appeal *per se*. Here attention must be called to a danger; it must be shown that the danger is a threat to the respondent: it must then be shown how the danger can be averted; and, finally, the respondent must be encouraged to decide upon and to take the appropriate action (thus relieving anxiety and consequently reinforcing the decision to act). For example: poliomyelitis cripples; it threatens *your child*: immunisation reduces the danger; protect your child: take your child to . . . where he will be immunised and thus protected.

But we should arouse fear only if no other motive is relevant. It is much better to appeal to the positive emotions: to the desire to know, to master, to achieve or to excel.

Response. The health educator fails unless he evokes a more healthy response, or at least prepares the way for it. So he must first define the problem clearly, take account of its emotional, social and moral as well as of its physical aspects, discover how it is perceived by the people concerned, appraise the influence of relevant beliefs, customs, taboos, prejudices, attitudes and practices, and assess his resources. Before the final scope of the project is settled, the problem should be thought of as a possible starting-point for wider health education.

When the first plan of the project has been drawn up, its possible repercussions upon the whole man, and upon society, should be critically examined. Will the proposals improve individual or community health, however little? Or will they injure one part of the personality or of the community while they benefit another, and thus, on balance, do more harm than good?

If the project, or some part of it, has survived this test, it should be broken down into daughter (but still related) projects which will be directed towards different sections of the community. These are: *policy makers* (government and local government legislators and officials); *natural educators* (doctors, dentists, nurses, teachers, health inspectors, youth leaders, industrial welfare workers, parents); the *training schools* for these natural educators (universities, training colleges, medical and nursing schools); *schoolchildren*; and the *general public* (subdivided into its natural groupings, by sex, age, socio-economic status, education, occupation, recreation).

The exact responses wanted from each of these sections should then be provisionally decided. These responses may not be immediately practicable. Although the ultimate goal must not be lost sight of, it may be necessary to aim first at simpler responses upon which a pyramid of new attitudes, habits, knowledge and skills can be gradually built, terminating with the desired, but at present unobtainable response.

When the immediate projects for any section of the community have been chosen, all available media of health education should be marshalled and allotted their specific but co-ordinated function. Within these immediate projects, each piece of health education undertaken through an individual medium should have its own clearly defined aim, which may be an early, intermediate or late step towards the desired response. It may therefore have one or several of the following purposes: to give or revivify information; to arouse latent interests or create new ones; to evoke higher aspirations; to remove prejudice or give knowledge; to encourage insights; to modify attitudes or behaviour in a particular direction.

Care must be taken, however, to exclude undesirable responses. A clumsy or condescending approach may lead to antagonism; demanding too much too soon may discourage; an appeal to fear may create anxiety; stress on disease rather than on health may result in an excessive concern with illness.

The sequence of steps in health education then is: first, establish the facts; second, assess opposing as well as favouring influences; third, decide what response is ultimately practicable, and by what stages it can be achieved; fourth, decide to which motives to appeal; fifth, use those media that will bring about the desired response at the least cost in time and money; sixth, try to ensure that the desired response consistently brings a satisfying reward, so that in time it becomes second nature; seventh, appraise the effectiveness of the different means of health education that have been used, and the changes that have been brought about in knowledge, attitudes and behaviour; and, last, replan in the light of these findings.

Methods

A detailed description of how each aspect of health education might be carried out will not be attempted here. In Britain, advice and help on specific projects can be obtained from:

The Central Council for Health Education, *Tavistock House*, *Tavistock Square*, *London*, *W.C.*1.
The Scottish Council for Health Education, 16 *York Place*, *Edinburgh*.
The Royal Society of Health, 90 *Buckingham Palace Road*, *London*, *S.W.*1.
The National Association for Mental Health, 39 *Queen Anne Street*, *London*.
The National Committee for Audio-visual aids in Education, 33 *Queen Anne Street*, *London*.
The National Marriage Guidance Council, 58 *Queen Anne Street*, *London*.
The Royal Society for the Prevention of Accidents, 52 *Grosvenor Gardens*, *London*, *S.W.*1.
The Central Council of Physical Recreation, 26 *Park Crescent*, *London*, *W.*1.
The Scottish Council of Physical Recreation, 4 *Queensferry Street*, *Edinburgh* 2.

In other countries, the Ministry of Health and the Ministry of Education (or their equivalents) should able to say what help is available and how it can be obtained.

Internationally, advice on health education can be got from:

The International Union for Health Education, 3 *Rue Viollier*, *Geneva*, *Switzerland*.

The Health Education Section of the World Health Organisation, *Palais des Nations, Geneva, Switzerland.*

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Chapter 22

CHILD HEALTH IN THE TROPICS

THE tropical areas of the world today are faced with problems affecting their childhood populations which extend far beyond those of exposure to a particular climate. For the most part, the tropics represent underdeveloped areas where the standard of life of the great majority of the indigenous population forms a striking contrast to that of the small minority who have achieved the highest levels of education and living; the contrast is not only between urban and rural populations, since the worst living conditions may be found in slum areas surrounding modern cities. Although tropical communities and cultures have through the centuries been subjected to change, occasioned principally by invasion, famine, and epidemic disease, new factors operating during the present century (and more particularly during the past twenty years) have accelerated change to an unprecedented extent. Political emancipation coupled with the emergence of ruling and professional classes famililiar with the European, American or Russian systems of education are resulting in pressures from within which are more irresistible and more radical than moulding from without. The construction of roads and the introduction of air and motor transport have been responsible not only for expansion of trade but also for migration and detribalisation. Probably the most important factor, however, in upsetting the equilibrium between reproduction and survival has been the spread of Western medicine. Although hygiene has lagged behind therapy, and many set-backs have occurred from failure to overcome prejudice or to understand local custom (Dorolle, 1953), modern methods of prophylaxis and treatment are, in fact, becoming increasingly accepted by native populations. Thus in yaws areas, the dramatic effect of intravenous arsenic on the primary and secondary lesions created confidence in the potency of intravenous injections, which has been followed by the even more impressive results of antibiotics.

When to therapy is added prophylaxis, including vaccination against smallpox, yellow fever and plague, control of malaria and sleeping sickness, and the provision of uncontaminated water supplies, it will be realised that a factor of enormous weight and potential has been thrown into the balance. It is, of course, true that the medical services are as yet far from adequate and in many areas rudimentary, and that global malaria-control alone will continue to tax their resources for years to come. But what is most significant is that the medical and sanitary services have already had a profound effect on population and survival and that their further development has been given high priority by native communities which have achieved or are approaching self-government.

Before considering the specific problems of child health in the tropics, therefore, it is essential to recognise that the fundamental issue is not the comparatively simple one of reducing infant and maternal mortality or of safeguarding the health of the schoolchild. It is rather that of achieving a stable balance between the increasing chances of survival and the food available to support the population. Industrial expansion and export are likely to provide at best only a partial solution for the problems of tropical areas, and it would appear that the results of control of disease must in the last analysis be met both by a corresponding increase in local food production and also by limitation of child-bearing. The necessity for limitation of population by contraception is being faced realistically in India, and has been accepted as a matter of social policy. Although the issue is still highly controversial and complicated by religious and moral doctrines, population control has entered a new phase with the introduction of an oral contraceptive of proved efficacy. For the maximum benefit to the childhood population to be achieved, however, it is important that contraception should be linked with intelligent family planning and the suitable spacing of pregnancies (Chapter 23).

Agriculture and Diet

Agriculture and husbandry are so closely related to the staple diet that they must be considered as forming an essential background to the problems of child health. Although there will be major differences between one tropical area and another, the occurrence of a wet season characterised by torrential rains and lush growth followed by a dry season during much of which food production is minimal, provides common problems. The heavy rains are apt to result in soil erosion wherever the land has been cleared of trees, and roads may become impassable for wheeled traffic. (It is significant that there is no indigenous wheel found in the culture of tropical Africa, and that the majority of market produce is still transported on foot.) The dry season is marked by enervating heat, dust, flies, and shortage of water, whilst pests and village fires make heavy inroads on stored harvests. Owing to the depredation of parasitic and other diseases, the raising of livestock is precarious throughout the tropics, whilst religious belief or local custom may exclude any or all animals as articles of diet or militate against the improvement of existing stock. Thus the pig is banned as unclean by Moslem communities. The Hindu religion, which regards the cow as sacred, not only necessitates an almost exclusively vegetarian diet for the majority but results in an enormous cattle-population of India which consumes much of the available food and contributes very little milk. In tropical West Africa, the extensive trypanosome belt is largely devoid of cattle (though attempts are being made to introduce stock immune to sleeping sickness); little of the meat and none of the milk produced in Northern Nigeria is available for the southern areas. Indeed, the nomad habits of the Fulani herdsmen in the north make them as much a liability as an asset owing to the destruction of crops which follows their wanderings, and so far have made the economic utilisation of milk, *e.g.* by drying, impracticable on any major scale.

It may be said that, with certain exceptions, meat contributes little to the staple diet in tropical areas, since even when stock can be successfully reared (*e.g.* pigs in Thailand and goats in many areas) the meat tends to become a cash product beyond the means of the average peasant or the animals are regarded as capital which is not readily expended. What is of even greater importance in considering the health of the infant and young child is the almost universal lack of milk. Even where milk is, or could be, available there is frequently a strong prejudice against its use. This is perhaps understandable in view of the very great likelihood of milk being infected at source or becoming contaminated.

In contrast to those communities depending almost exclusively on tilling soil which is yearly being washed away, river and coastal dwellers have tended to base their economy on fishing. The liberal inclusion of fish in their diet is commonly recognisable at an early age in the physique of the children. Whereas young children weaned on to an exclusively vegetable diet tend to develop large protuberant abdomens (accentuating the commonly seen umbilical hernia) children in fish-eating communities do not. There is also suggestive evidence that both childhood and terminal stature is greater amongst fish-eaters than in those areas where foods with high protein content are scarce. It is possible that improved transport and methods of preservation may in time render fish a valuable supplement to the diet of populations living at a distance from sea or river, whilst in some rice-growing areas 'fish-farming' on the flooded rice-fields has been introduced with the same purpose.

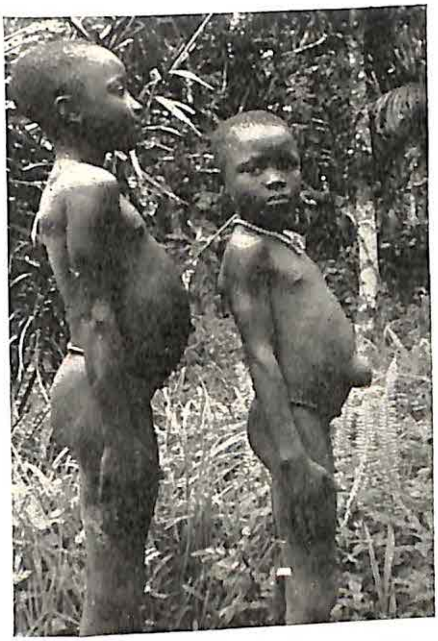

FIG. 75. West African children from a village where the staple diet is cassava, showing distended abdomens and umbilical hernia.

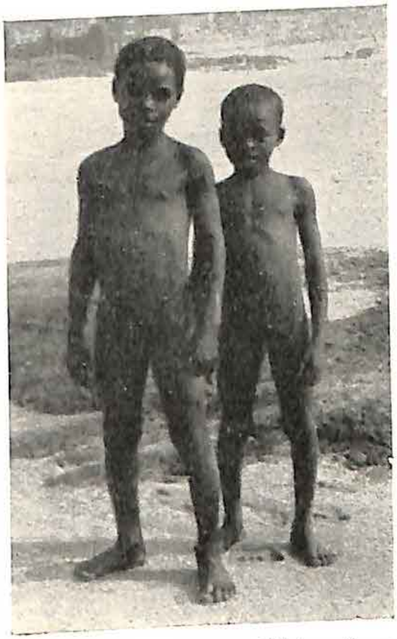

FIG. 76. West African children from a fishing community, showing contrasting physique from Fig. 75.

At the present time, food production in the underdeveloped areas is being faced as a world problem by co-operation between local governments and the United Nations working through the Food and Agriculture Organisation (FAO). The provision of expert advisers, agricultural equipment, and training of native personnel has been accepted as a responsibility by the more favoured nations, and there is no doubt that real progress is being made through international co-operation and mutual aid. But without minimising the present achievements or future possibilities of development of the tropical areas, it is extremely dubious whether food-production is in fact keeping pace with population or is within measurable distance of doing so. Calder (1954), who wrote with enthusiasm of the prospects of development, also stated, 'Seventy per cent of the Asian peoples depend on rice as their staple diet and, while the population has increased by over 10 per cent since the outbreak of the Second World War, the rice production is no greater, and in India considerably less, than in 1939'. This difference in tempo between control of disease (and hence increase in population) and increased agricultural production is partly accounted for by a greater reluctance to accept new agricultural methods, systems of land tenure, and dietetic habits than to accept Western medicine. Partly also, it stems from the fact that control of epidemic disease is in many areas a necessary precursor of agricultural or other development (a lesson learnt from the construction of the Panama canal, which was only possible after the area had been cleared of yellow fever). This inevitably leads to a time lag between the operation of the medical services and the increased productivity which may follow. Unfortunately, also, visiting foreign experts have not always been fully aware of local conditions, native customs, and religious beliefs before advising on major undertakings, and a number of costly failures have taught the necessity for local co-operation.

Apart from an increase in the staple diet, however, there are undoubtedly potential sources of food in many areas which are not fully utilised. Williams (1954) in discussing the real needs of the underdeveloped countries, has stressed the role played by ignorance as a cause of malnutrition. De Silva (1951) has also emphasised that in Ceylon malnutrition is due more to poverty than to shortage of food. In tropical Africa there are many potential foods which are either taboo or which are not eaten from ignorance of their value, whilst others are squandered owing to difficulties of transport or preservation.

Since major increases in food-production may take many years to achieve, the immediate necessity is for the existing resources to be fully utilised and for wastage to be reduced to a minimum. This can only be brought about by education at every level, designed to render the particular population concerned best able to be self-supporting and self-sufficient. It must be remembered that an educational system suitable for an industrial population in a temperate climate may be largely inappropriate for one which has widely different problems to face and a completely alien culture. There is an obvious danger in allowing the principles of fundamental education to be lost in the rapid expansion of elementary education with an acute shortage of fully trained teachers, whilst literacy itself is too often regarded simply as the road towards black-coated employment and away from manual labour or craftsmanship.

Environmental Sanitation

Whilst adequate nutrition may be regarded as a basic need of any human community, nutrition is closely linked with environmental sanitation and the control of infectious disease. In the underdeveloped countries, much of the value of the limited food available is lost as the direct result of intestinal parasitic infestation and of the diarrhoeal disorders. These in turn are primarily the result of insanitary disposal of excreta, and of the contamination of soil and water. In South East Asia it is common to see the same canal, or even stagnant

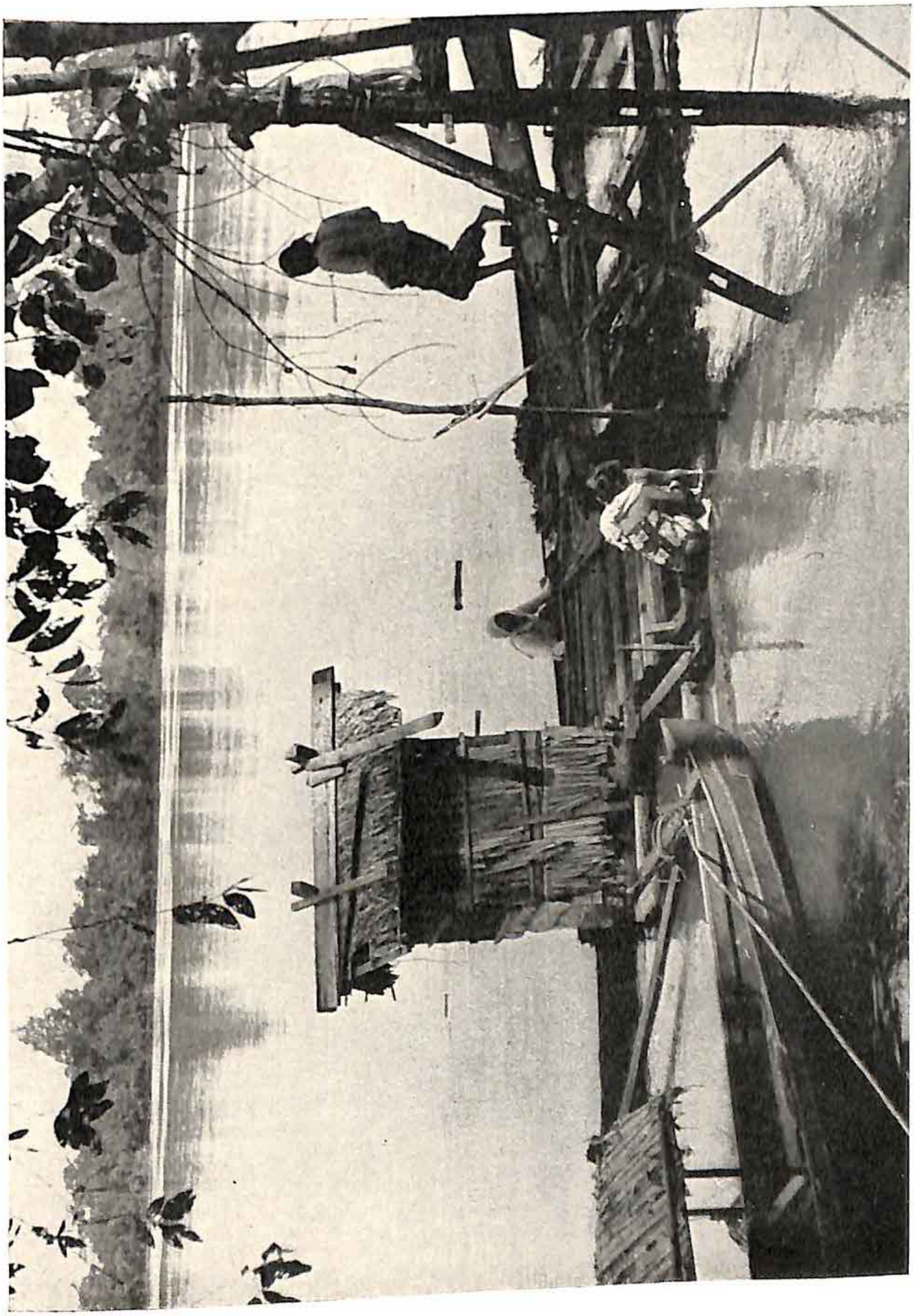

FIG. 77. Environmental sanitation (Indonesia). The small hut serves as latrine, bedroom and storage for fishing nets. All transport in this area is by dug-out canoe, and the river is infested with crocodiles.

water, being used indiscriminately as latrine, laundry, bath and drinking reservoir.

Of the more important intestinal parasites, *Ascaris lumbricoides*, hook-worm and whipworm are spread by the ova escaping in the stools and becoming infective in contaminated soil; in the case of *Strongyloides stercoralis* the larvae are passed. Infestation with *Ascaris* and whipworm occurs by ingestion of contaminated food and water, whilst the larvae of hook-worm and *Strongyloides* cause infestation by penetration of the intact skin, as may occur when children are walking barefoot on infected ground. Whilst children are probably the greatest sufferers and principal source of spread, the problem of intestinal parasitic infestation is essentially one affecting the whole community and can only be satisfactorily solved by health education leading to sanitary disposal of excreta.

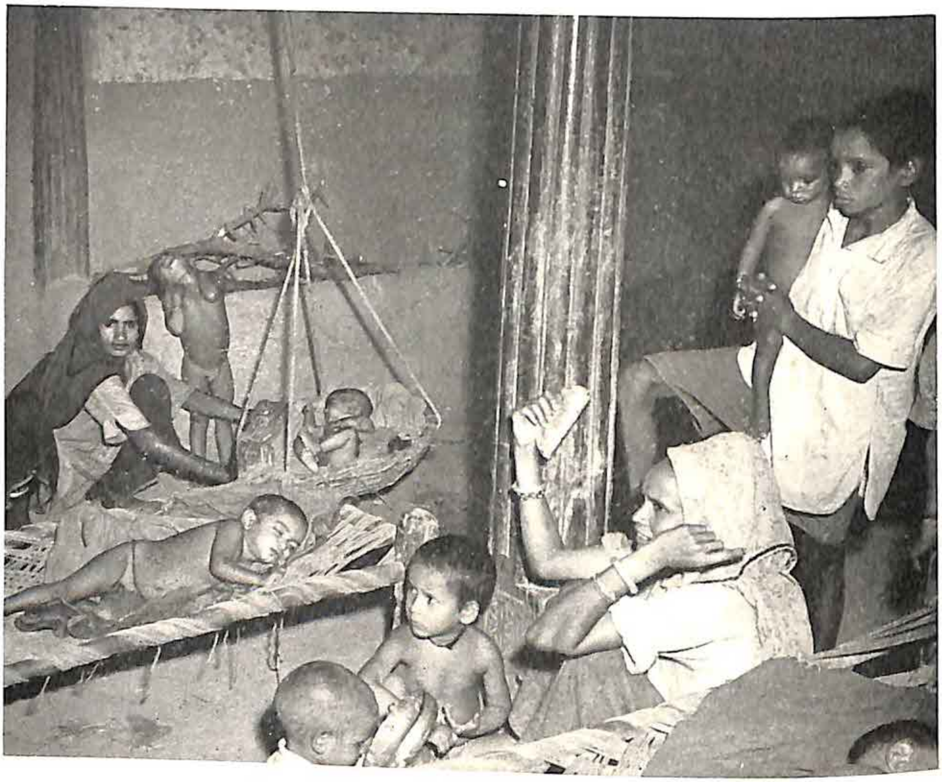

FIG. 78. Overcrowding in an Indian home.

Bilharziasis, which involves the liver, viscera, and genito-urinary tract or rectum, and causes very great disability in children in endemic areas, is transmitted by bathing in infected water which harbours the intermediate host (a mollusc). The ova are excreted in the stools or urine. Whilst personal hygiene plays an essential part in control of the disease, the provision of piped water for bathing, and the use of molluscicides to destroy the intermediate host in natural waters are also important methods of attack.

The diarrhoeal disorders, of which *Shigella* infection is now probably the chief pathogenic agent in adults and children, account for a major part of the infantile mortality in many areas, and for high morbidity in childhood throughout the tropics. (In a study of protein malnutrition in children under five in Southern India, it was found that 25 per cent of those examined had a history of recurrent diarrhoea, and that approximately 15 per cent were suffering from diarrhoea at the time of the examination.) In prevention, objectives must include not only the safe disposal of excreta, but also the provision of easily-accessible piped water, reduction of the fly-index, and improved standards of food handling.

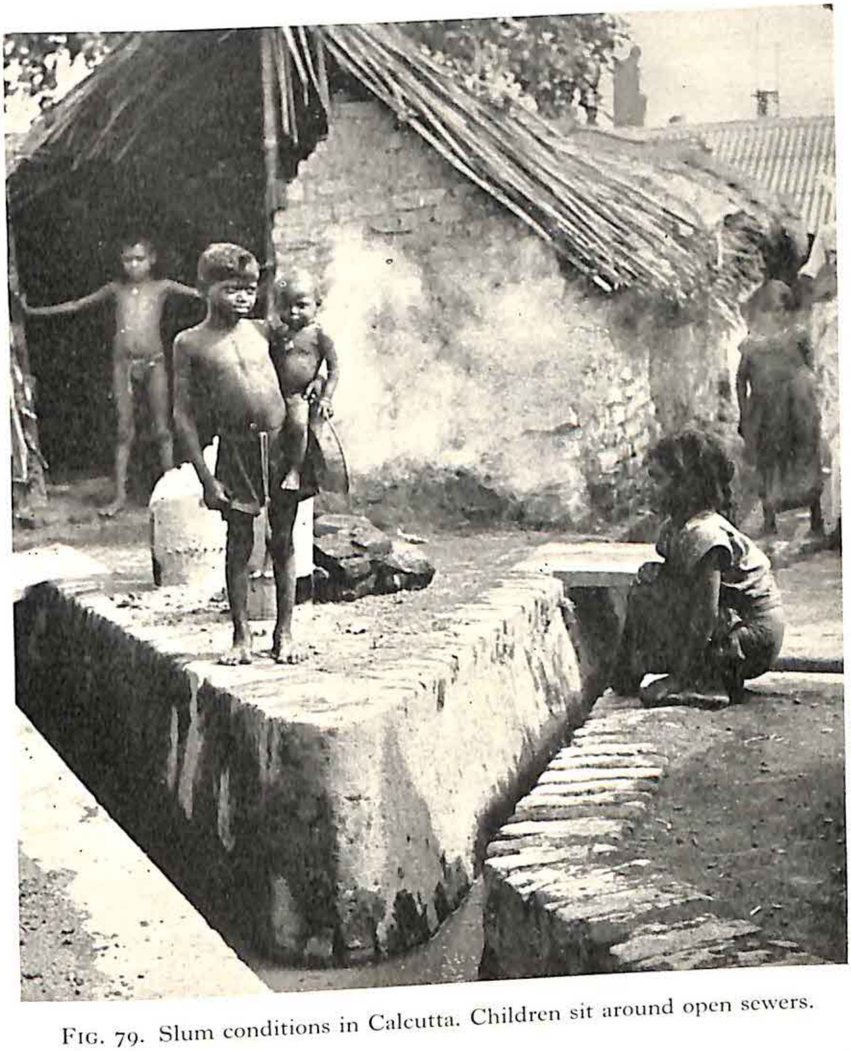

FIG. 79. Slum conditions in Calcutta. Children sit around open sewers.

Overcrowding. Overcrowding in the home, commonly associated with inadequate ventilation, is a major factor in the spread of infectious and contagious disease, and is seen at its worst in the larger cities. The nidus of childhood infection is most commonly found within the family, and in the case of pulmonary tuberculosis, usually in an adult with whom the child is in close contact. The crowding together of large families including adults and children of all ages is particularly favourable to the spread of tuberculosis, and this is in fact one of the most widespread and lethal diseases of underdeveloped countries.

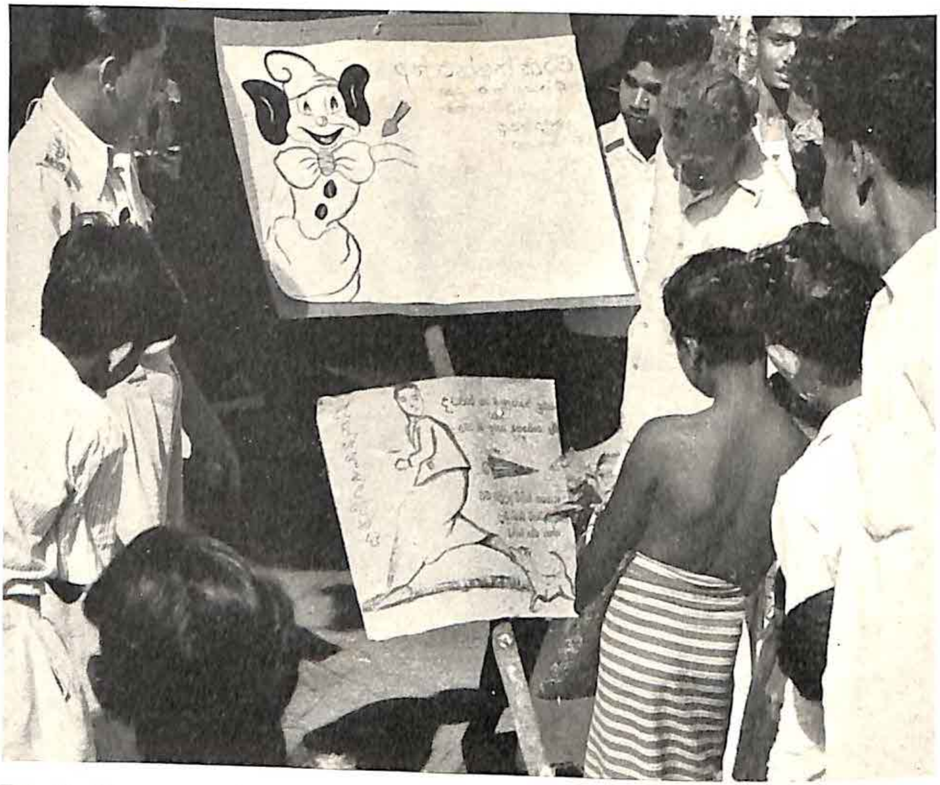

FIG. 80. Street corner health education in Ceylon. Posters explain the necessity for vaccination against typhoid, smallpox and rabies in order to attract volunteers to the tent where a public health nurse carries out vaccinations. WHO/Photo 5406.

Infant Mortality

It is only possible to speak in general terms of the infant mortality in many tropical areas owing to the paucity of reliable vital statistics. Such figures as are available for the more populous and developed areas, where registration of births and deaths may be effected with some approach to accuracy, can certainly not be taken as applying to remote and forest areas where the population may be almost wholly illiterate, infant deaths are regarded with fatalism, and the desirability of recording them in no way understood. In such areas, we are largely dependent for information on isolated field studies carried out by trained observers able to study small and stationary communities, observing each woman of child-bearing age over the necessary period, and recording the result of each pregnancy. In one such study by Harding (1948) in Sierra Leone, the infant mortality rate was found to be 417 ± 48 per 1,000 live births in one year which was marked neither by famine nor major epidemic disease. Onabamiro (1949) reviewed the information then available for West Africa, and various authors (*e.g.* Jelliffe, 1952) have estimated that from 300 to 500 of every 1,000 live-born babies die in infancy.

If 'infancy' is taken as the first five years of life rather than the first year only, this is probably still largely true in some areas. Even the official figures applying to the capital cities of the West African territories where medical and social services tend to be concentrated, are still excessively high by modern standards. Whilst West Africa is here taken as an example, comparable data suggest a similar overall picture in other tropical areas, and it must be remembered that floods or epidemic disease may produce peak years in mortality which are now seldom seen in temperate climates.

It is probably no exaggeration to say that in some of the underdeveloped tropical areas of the world, the mortality of infants and children under five years of age is at least six to ten times as high as it is amongst the most favoured nations.

Causes. In considering the causes of this extremely high mortality during the first five years of life, it is advisable to break it down into age groups although there is insufficient data to assess at all accurately the relative contribution of each period. It may be borne in mind, however, that in the countries where a rapid fall has occurred in infant and childhood mortalities during the present century, the greatest absolute decrease has been in deaths under one year, but the greatest relative decrease in deaths in the age group one to five years. It is certainly true of the tropical areas that (as in Great Britain in the nineteenth century) the greatest number of deaths occur during the first year, but that an immense saving of life could be effected in the age group one to five years. It is also generally true that where there is a high infant mortality rate, the stillbirth rate is also high and that this helps to make the foetal wastage still more excessive.

Neonatal and birth-deaths. Infant deaths which are the direct result of delivery are essentially an obstetric problem, and in most areas the obstetric services are expanding rapidly through the setting-up of village maternity units and the training of native midwives. Local religious practice, *e.g.* purdah, however, may militate against institutional delivery. On the other hand, where the obstetric services are readily accepted, accommodation is apt to become so overcrowded that discharge on the first or second day after delivery results in many preventable infant deaths. In units where it has been possible to aim at retaining mother and infant until the cord has separated, the practice appears to have been amply justified.

Since the great majority of deliveries are still domiciliary, however, there remains an immense field not only for expansion of the supervisory services but also for general education of women in hygiene and infant care. It is still not very uncommon for cases of obstructed labour to reach hospital when the mother is almost moribund, or where sepsis has occurred through interference and the introduction of septic material into the vagina. Female circumcision,* with consequent cicatrisation, is said to account for a significant number of difficult deliveries in areas where it is a usual practice.

Neonatal deaths which are not the direct result of delivery will also be influenced to a great extent by local custom. Where delivery takes place on the mud-floor of a hut and the cord is cut with an instrument that has not been sterilised, there is a common risk of umbilical sepsis or tetanus. The likelihood of neonatal tetanus occurring is increased when mud or dung is used for dressing the cord, and there is no doubt that in many areas tetanus is, in fact, an important cause of neonatal death (Jelliffe, 1951).

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* Female circumcision, which is sometimes performed in infancy but more commonly at puberty, may consist of clitorectomy alone or with extensive excision of the labia minora and incision of the vulva. It is still practised in many parts of Africa, and carries the common risks of sepsis and haemorrhage in addition to those of later scarring. An account of the rite in Sierra Leone is given by Gervis (1952).

The practice of forcing fluid, *e.g.* by cupping the hand round the infant's face and pouring a stream of water over the nose and mouth, or of immersing the infant's head in water shortly after birth (as amongst the Fulani), is liable to lead to suffocation or inhalation pneumonia, and the same applies to forcing 'pap' into the mouth of the newborn. (A belief exists amongst some West African tribes that colostrum is dangerous, and the infant is kept from the breast for three or more days after birth.)

Amongst many unsophisticated populations there is a natural prejudice against gross congenital deformities, and affected infants rarely survive. (A curious exception in Southern Nigeria is albinism, which is relatively common, although it provides a handicap in a tropical climate.) In some communities there still exists a strong prejudice against twins and multiple births, and in others considerably less care is taken in ensuring the súrvival of female than of male infants.

With regard to congenital malaria, it is known that parasites can pass the placental barrier and cause death within the first three days, and this has been demonstrated in the case of infants of European mothers delivered in the tropics. The present evidence suggests, however, that true congenital malaria is rare in native infants (Covell, 1950), though infection shortly after birth may (if sufficiently heavy) overcome any existing congenital immunity.

During the latter part of the first month of life, bacterial and parasitic infections play an increasingly important role in causing respiratory and diarrhoeal disorders. Deaths from 'convulsions' are frequently recorded, but as these may be due to neonatal tetanus, sepsis, meningitis, malaria or birth injury, there is need for more accurate diagnosis if treatment and prophylaxis are to be effective.

Postnatal deaths and morbidity. During the first year, the almost universal practice of breast feeding in unsophisticated communities provides some protection against the diarrhoeal disorders, though these nevertheless carry a substantial mortality, and rank with respiratory infections as one of the major causes of death. Despite breast feeding, worm infestation becomes increasingly common during the first year of life, and may be remarkably heavy, *e.g.* 100 adults ascaris sometimes being passed by an infant of twelve months. Whilst ascaris infestation seldom endangers life, except occasionally by causing obstruction, it is undoubtedly a contributory factor in causing digestive and nutritional disorders. (The role of hookworm infestation in causing anaemia in infancy and early childhood is probably related both to the actual load of parasites carried and to the basic nutrition of the child, since an iron-deficient diet will render adequate compensation for blood-loss difficult or impossible.) Of the common childhood diseases, pertussis and measles take a much higher toll of infant life than they now do in temperate climates. The infant during the first year is exposed to the infections prevalent in the particular area, *e.g.* malaria, smallpox, meningococcal meningitis, dysentery, trypanosomiasis, etc. Whilst these are responsible for a high mortality in the younger age groups the problems are primarily those of general control. The reaction to the first infection with malaria appears to vary widely with individual immunity. Bruce-Chwatt (1952) has described five types of response by newly infected infants, varying from severe loss of weight and inability of the young organism to cope with the infection, to a minimal reaction with normal weight-gain (which he regards as high inherited tolerance to the malarial parasite). During the first three months of life the infection rate was found to be lower than might be expected from the length of exposure in a highly endemic area, but by the age of twelve months, over 80 per cent of the infants studied had become infected (Fig. 81).

Later infancy and early childhood. (One to five years.) Whilst the nutrition of the young infant is commonly safeguarded by breast feeding, nutritional disorders account for a high mortality and morbidity when the age of weaning is reached. Although it is usual for breast feeding to be continued for two years or more, lactation is often inadequate in quantity rather than quality after the first year. During the period of supplementary feeding, *i.e.* when soft solids are being given in addition to the breast even a small amount of breast-milk may protect the infant against severe protein deficiency, which is often precipitated when the infant is completely weaned. Semi-solid food, *e.g.* premasticated plantain, millet porridge, or cornflour, is given at a variable age depending on local custom and staple diet, but as a general rule there is little attempt to provide food suitable for the infant, whilst the toddler is almost wholly dependent on the adult diet. Although there are exceptions, the infant commonly receives little or no milk after lactation is exhausted, and where the staple diet is a vegetarian one his diet may be grossly deficient in first-class protein. It must be emphasised, however, that there are wide variations in the nutritive values of plant proteins, and increased attention is being focused on the use of locally available plant proteins in infant and child feeding. Thus in Central America a protein-rich preparation, Incaparina (consisting of 38 per cent cottonseed flour, 29 per cent corn meal, 29 per cent sorghum, 3 per cent Torula yeast, 1 per cent calcium carbonate and

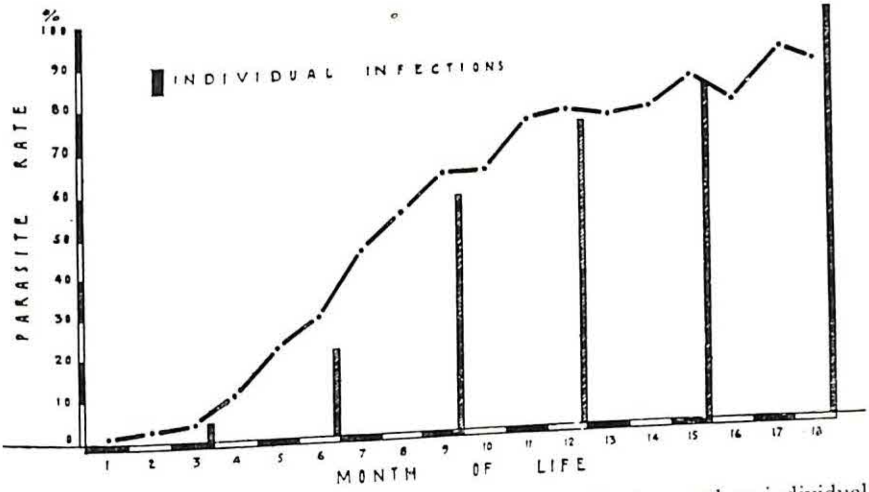

FIG. 81. Parasite rates as random sample of all examinations and as individual infections in 138 African infants. (From Bruce-Chwatt, L. J., 1952, *Ann. trop. Med. Parasitol.*)

vitamin A at 20,000 i.u./lb.) has been produced by the Institute of Nutrition of Central America and Panama. It superficially resembles the maize gruel in common use, and has been successfully marketed on a commercial basis.

KWASHIORKOR, the vernacular name applied to a disease described in the Gold Coast by Williams (1933, 1935), is a condition occurring particularly in this age group. It is characterised by failure to thrive and retardation of growth; apathy, anorexia, and misery; and by loss of normal pigmentation of the hair and skin. The hair which in dark-skinned races is normally of crisp texture and deeply pigmented, becomes fine, silky, and reddish-grey or even silvery in colour, whilst the skin loses the normal dark 'gloss' that is characteristic of the healthy infant.

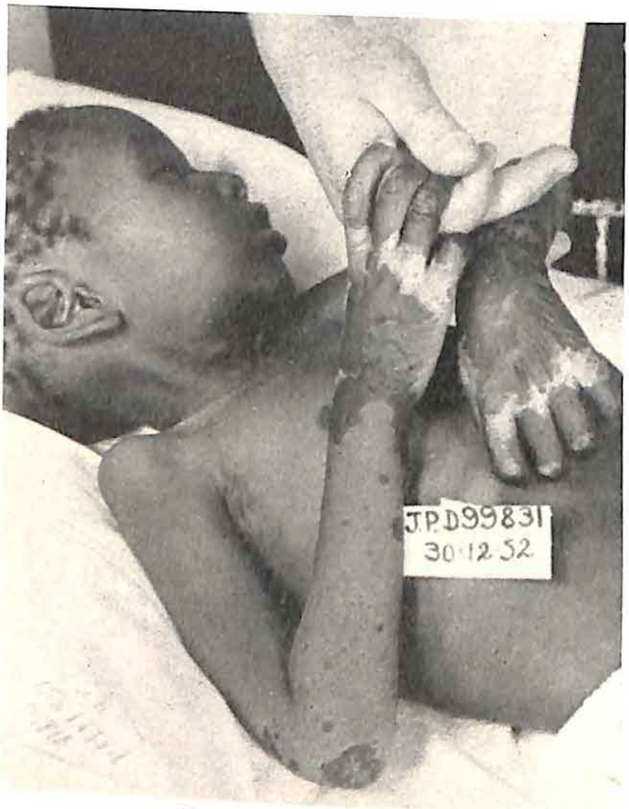

FIG. 82. Kwashiorkor.

(Whilst these pigmentary changes must be distinguished from the skin and hair colours of the albino, semi-albino, and racial cross, which are of genetic origin, the general picture of Kwashiorkor is usually sufficiently characteristic to prevent confusion.) In addition, a variety of dermatoses occur, of which a crazy-pavement rash on the lower legs, napkin area, back or abdomen is the most characteristic. Oedema is a classical feature of the disease, and may mask the true degree of wasting. The liver undergoes fatty or fibrotic changes, and there is atrophy of the pancreas and intestines. Fatal cases frequently show evidence of associated respiratory infection. In South East Asia, Kwashiorkor is often associated also with evidence of vitamin A deficiency, though this is not an integral part of the syndrome.

If untreated, the disease in severe form carries a high mortality, but the description 'malignant malnutrition' is not now generally regarded as acceptable, since many cases can be saved by treatment with skimmed milk. The exact relationship of Kwashiorkor to hepatic degeneration with or without oedema in older subjects, which is widespread in the tropics, is still debatable, but it is probable that protein deficiency is at least one common aetiological factor in both groups.

Kwashiorkor has been observed in almost all underdeveloped countries where protein deficiency is at all common. Whilst these are not exclusively tropical, they include Ghana, Nigeria, the Congo, West Indies, Cuba, India, Indo-China, Thailand, Indonesia, Ceylon and Malaya. The disease occurs (1) in the age group in which protein requirements are high and (2) amongst peoples whose diet is deficient in protein-rich food and where the ratio of protein to carbohydrate foods is low (Trowell, 1954). It is seen particularly but not exclusively where the staple diet is maize or tropical roots such as cassava or manioc which are deficient in methionine. Kwashiorkor is a preventable disease and provides an important index of protein-deficiency attacking a particularly vulnerable age-group. Where Kwashiorkor is common, every severe case is likely to be associated with a number of mild cases, and evidence of protein deficiency

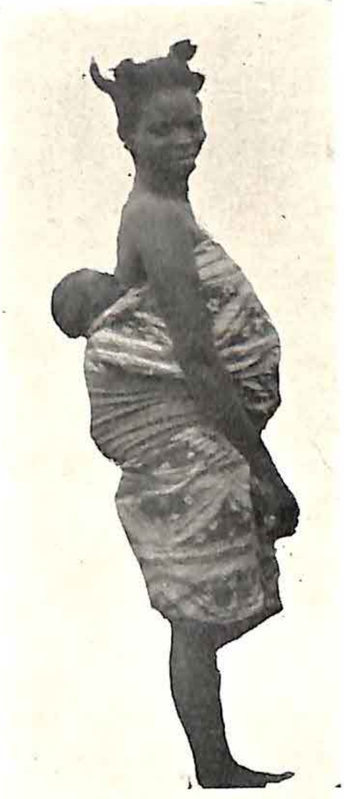

FIG. 83. The young infant is commonly carried on the back (in Africa) and breast-fed on demand.

will also be found in the adult population, particularly in pregnant and nursing mothers.

OTHER HAZARDS. During the one to five year period, the young child commonly experiences a profound change in the mother-child relationship and increased exposure to risks of every kind. Whereas the young infant is commonly carried on the mother's back and breast-fed on demand, the older infant is often delegated to a small sister, whilst the toddler is left to a much greater extent to fend for himself, particularly when he has been succeeded by another baby. The picture of the malnourished 'deposed child' of three or four beside the healthy baby at the breast is a familiar one. At the same time his mobility exposes him to greater environmental risks under conditions of primitive sanitation and hygiene. Apart from threadworm infestation, *Ascaris lumbricoides* is the most ubiquitous type of worm infestation in the tropics, and is commonly acquired in early childhood. Where hookworm or schistosomiasis is endemic the child is likely to become infected from contaminated soil or water. In malarial areas the infection rate reaches its peak incidence. (The 'spleen-rate' in this age group is often used as a rough index of malarial infection of the community, and serves this purpose in endemic areas although it should be borne in mind that the spleen enlarges readily in early childhood from causes other than malaria.) The mortality and morbidity from malaria in infancy and early childhood in the tropics is still prodigious, and where the disease is holendemic the adults who survive represent a 'salted' community where immunity has fought a more or less successful battle with infection. There is also evidence that malarial infection in childhood is a contributory factor in producing the liver damage which is almost universal in many areas, and that chronic malaria and malnutrition are together responsible for the greatest loss of work potential in the underdeveloped territories. In 1952 it was estimated that the total annual number of cases of human malaria averaged 350 million, with a mean mortality of one per cent, a substantial proportion of which occurred in infancy and childhood. Since the introduction of modern insecticides and house-spraying, however, the disease has been eradicated in a number of countries and others are progressing toward this state.

Later Childhood

Although the older child is subject to the common risks of the area in which he lives, including infection, malnutrition, and trauma, there is no doubt that the mortality between five years and adulthood is very much less than in infancy and early childhood. To an increasing extent, boys of school age are coming under supervision which makes both treatment and prophylaxis more readily feasible. In the case of girls, where education in the basic principles of health, diet and infant hygiene is most needed if major progress is to be effected, there has been much more apathy or active hostility to bringing them into the educational system. Even in areas where elementary education is being demanded by the native population, it is often found that the school population includes only one girl to every ten or more boys (Fig. 93). In Moslem communities and others where purdah is practised, there is particular difficulty in bringing education to girls of school age and even more so in training older girls to form the nucleus of the teaching, health visiting, nursing and other professions in which their co-operation is most needed. Many experienced workers feel that the spread of female education (which should be directed in the first instance to fitting girls for intelligent motherhood rather than for purely academic posts) is a fundamental step which must be taken if the underdeveloped countries are to go forward.

The health problems of the child of school age are, as has been mentioned, essentially those of the community in which he lives but two conditions which can be attacked intensively in this age group call for special mention.

Yaws, of which the geographical distribution is shown in Fig. 86, is essentially a disease of tropical and near-tropical areas. It is due to infection with a tryponeme (*Treponema pertenue*) which has many affinities with *Treponema pallidum*, the causative organism of syphilis. The infection is not, however, venereally acquired, and the consensus of opinion is that infection takes place at the site of an abrasion by contact with infected material, usually by direct body-contact.

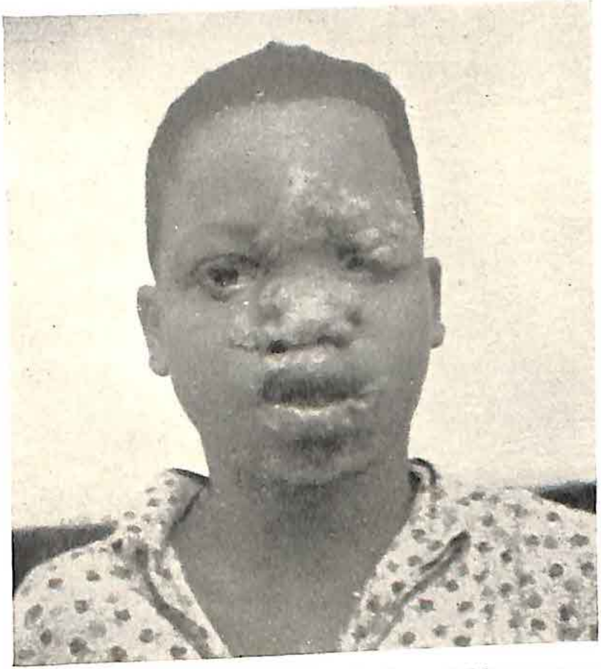

FIG. 84. Facial yaws in a Nigerian boy of thirteen years.

Studies in Jamaica (Chambers, 1938; Turner and Saunders, 1935) indicate that the peak incidence of primary infection is in the second five years of life, and that the commonest site is on the lower extremities (which are most liable to minor trauma when children are walking unshod through the bush). The crowding together of naked children on the floor of a hut at night is particularly likely to spread infection, whilst in the case of breast-fed infants a mother-child infection may pass in either direction although the condition is not congenitally acquired. The incubation period is thought to be three to four weeks.

After a variable period the primary infection is followed by secondary lesions, which include the characteristic 'framboesial' eruptions, and maculo-papular and pustular rashes. Since the disease is not painful at this stage, and does not interfere with normal activity, children are often not brought for treatment whilst the condition is still infective and readily curable. Indeed, in some areas yaws is regarded as almost inevitable, and children may even be deliberately infected.

The tertiary lesions are likely to appear in later childhood or early adult life, and in contrast to the primary and secondary lesions, are liable to be intensely painful when they involve the bones or plantar surfaces. Gummata may cause very extensive destruction of superficial tissues and great deformity though (unlike syphilis) yaws does not typically result in visceral, vascular, ocular or neurological manifestations. Whilst not a killing disease, tertiary yaws is certainly responsible for great disability and suffering throughout the tropics.

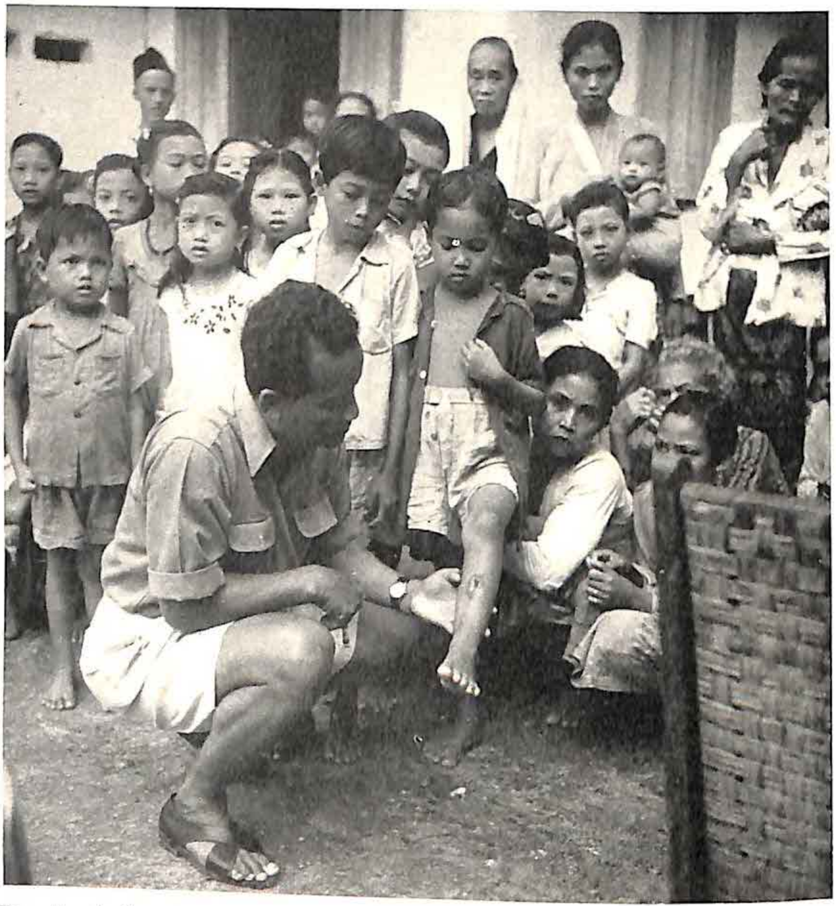

FIG. 85. Indonesian yaws eradication team visiting one of the smaller islands. The population was systematically examined, and cases of yaws treated with a single injection of PAM. In ten years, 34 million people were examined, and 5·5 million infected persons treated.

Some indication of the magnitude of the yaws problem in Africa alone was given by Hackett who stated in 1954: 'In the area of Africa in which yaws is endemic, the total population is about 103 million, the total annual sick attendance is 24 million (about 23 per cent), and yaws attendance is 1·32 million, that is about 5 per cent of the total sick attendance or about 1 per cent of the total

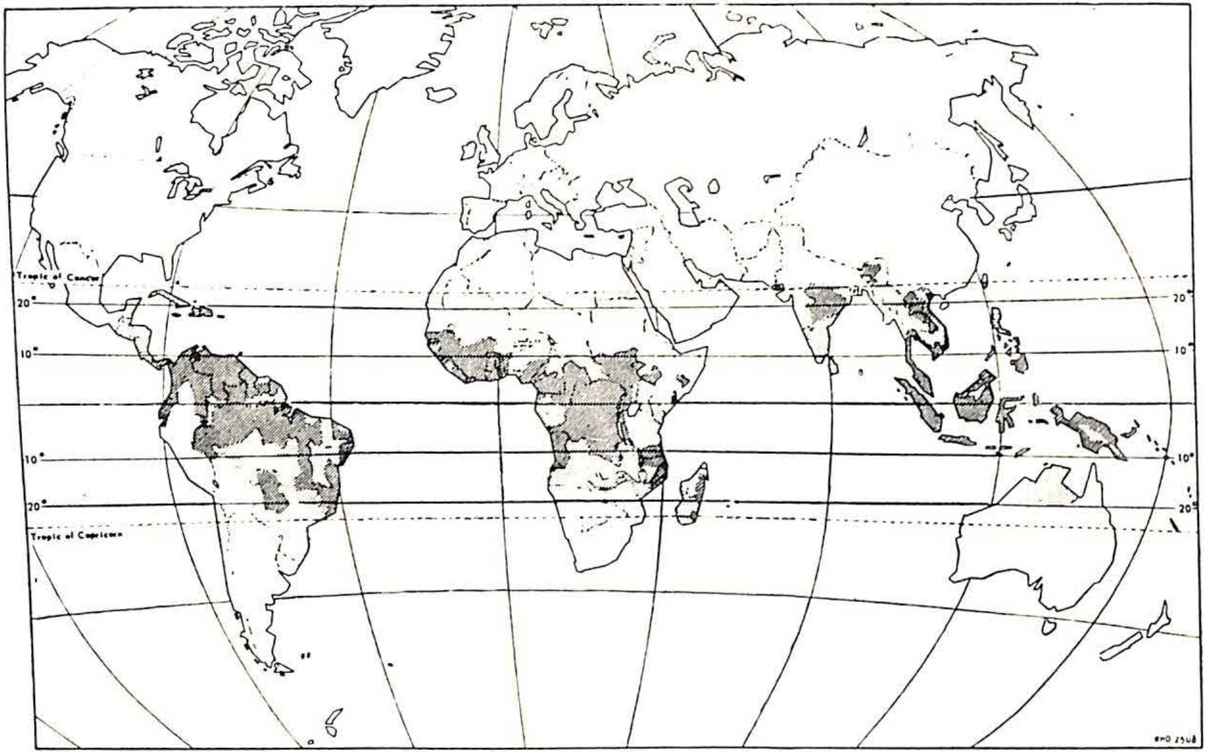

FIG. 86. The yaws areas of the world.
Darkly shaded areas—yaws widely prevalent. Stippled areas—yaws known to be present.
(*Courtesy of W.H.O.*)

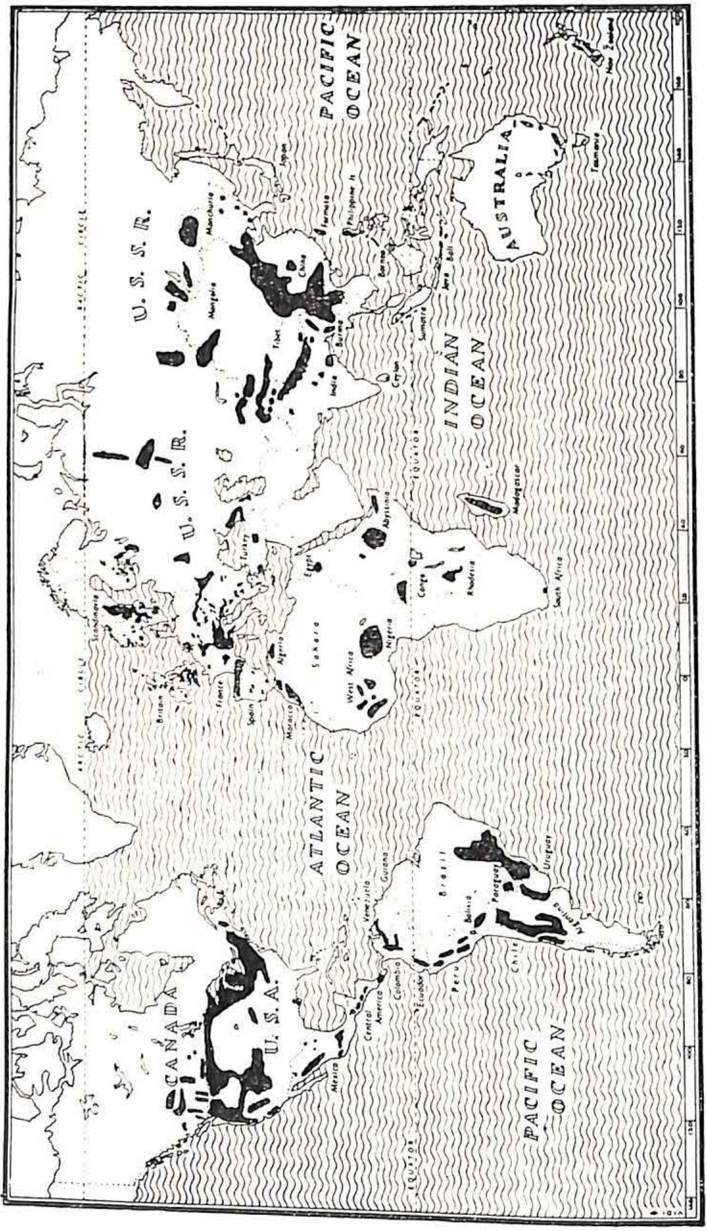

FIG. 87. The goitre areas of the world.
(*Courtesy of the Chilean Iodine Research Bureau*)

population. These figures can be safely regarded as under-estimates.' In Indonesia, when the anti-yaws campaign was started in 1950, approximately 15 per cent of the population was infected.

Yaws is most effectively attacked in the primary and secondary stages, since early treatment can result in complete cure and at the same time eradicate sources of infection. When repeated injections of intravenous arsenic provided the best method of treatment available, it was often found that the rapid disappearance of primary and secondary superficial lesions resulted in many patients failing to complete an adequate course of treatment and subsequently relapsing. More recently, using penicillin, large-scale anti-yaws campaigns have been carried out under the guidance of WHO, supplies being provided by the United Nations International Children's Emergency Fund (UNICEF). Treated areas include Haiti, Indonesia, Thailand and the Philippine Islands. With the long-acting penicillin preparations now available, control or local eradication of the disease is at least possible by intensive mass treatment, provided that the methods of the initial campaign can be consolidated into the health-services of the area.

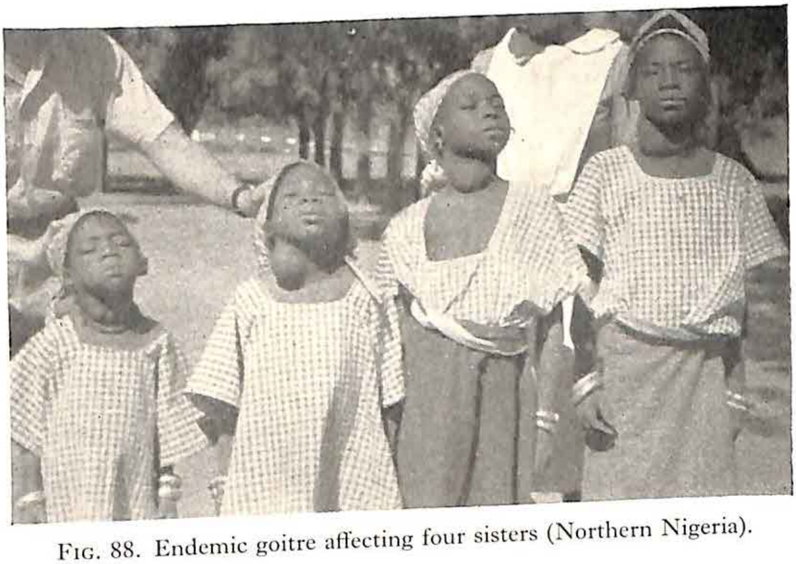

FIG. 88. Endemic goitre affecting four sisters (Northern Nigeria).

Endemic goitre. The geographical distribution of endemic goitre (Fig. 87) is widely different from that of yaws, and is not limited to tropical areas. It represents, in contrast, a world problem which has largely been solved in the more advanced areas but is still practically untouched in affected parts of the tropics. In these areas, thyroid enlargement may be evident in 50 per cent or more of girls of school age and a relatively lower percentage of boys. It is often present in infancy or early childhood, and several members of a family may be affected (Fig. 88). The condition tends to become more severe in succeeding generations, and the relationship to endemic cretinism and also to associated deaf-mutism is well recognised. Although the etiology is complex and various dietetic factors, faecal contamination of water supply, etc., have been introduced into the picture, it has been repeatedly shown that there is a close relationship between a high local incidence of endemic goitre and low iodine-content of water (and hence of vegetables grown from it). This has been demonstrated in Nigeria and Ceylon by Wilson (1954), who also emphasised the importance of geological formation and the 'leaching' effect of tropical rain.

Prophylaxis is readily undertaken in those countries where refined salt is used, and where large-scale iodisation of such salt can be effected before distribution. For this purpose, potassium iodide in a proportion of 10 mg. per kg. has been found effective in temperate climates, and has served to eradicate endemic goitre in many areas. In Northern India and in the tropics generally, however, the problem of prophylaxis is much less simple. Native populations generally are used to eating crude salt, which may be produced by evaporation of sea or salt-lake water, burning of vegetable matter, or mining of local rock salt, and which often has a negligible iodine-content. The practical difficulties of iodising this on the spot are formidable, whilst a change in age-old dietetic habit, *e.g.* to the use of pre-treated refined salt, is apt to meet with great opposition. Furthermore, potassium iodide is unstable under tropical conditions, and treated salt rapidly loses its iodine-content from the action of humidity, heat, and storage. Recent investigations indicate that potassium iodate, which is much more stable than iodide, is equally effective in prophylaxis and can be added in suitable dosage to either salt or flour without toxic effect (Study Group on Endemic Goitre, 1953). Whilst this represents an important advance, the problems of effective distribution still have largely to be overcome.

Native Custom and Child Health

Although the child before puberty is, in general, subject to comparatively few restrictions compared with the adolescent or adult, survival is often prejudiced even before birth by local custom relating to pregnancy and parturition. Trant (1954) in describing some of the numerous food-taboos current in East Africa points out that deprivation falls particularly heavily on the pregnant woman since she must not only avoid the foods which are generally taboo to women (which may include eggs, fowls, mutton, pork, milk and fish) but also observe further restrictions for fear of damaging the foetus or prejudicing her confinement. The extreme degrees of anaemia of pregnancy which are common in most tropical areas are often largely attributable to local custom, which may insist that the foods of higher nutritional value are reserved for men or sold as a cash crop and that pregnancy (far from necessitating a better diet) is essentially a period of prohibitions.*

In almost all primitive communities, parturition and the puerperium are surrounded with a variety of rituals, some of which are innocuous (*e.g.* disposal of the placenta or cord, ritual purification after childbirth) whilst others may directly affect the survival of the child. The risks of sepsis or tetanus are common to all types of native delivery where no precautions are taken to guard against them, but are enormously increased when obstructed labour leads to unskilled interference. In many communities the cord is not cut until the placenta is delivered, and whilst this will have no adverse effect in a normal delivery, prolonged retention of the placenta may be responsible for the death of the child. Cutting and dressing the cord (which have already been referred to in relation to neonatal tetanus) are effected in various ways, and the cord may either be tied with fibre or thread or (particularly when torn, bitten or cut with a blunt instrument such as a stone or bamboo knife) left untied. The risks of haemorrhage from the cord are, of course, greater when a sharp instrument is used.

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* There is evidence that the African newborn infant is smaller than the European or North American, *e.g.* an average birth-weight of 6 lb. 5 oz. in Ibadan (Walker, 1950) as compared with an average of over 7¼ lb. shown from recent American and British studies, a difference which is significant even allowing for differences in sampling. Although it has been argued that smaller birth size reduces the risks of difficult delivery, there is nothing to be said in favour of the low-protein, iron-deficient diets often enforced on pregnant women in the tropics.

Whilst in some nomadic communities the mother is expected to return to full activity almost immediately after delivery, the puerperium is often a time of more or less prolonged seclusion until ritual purification has been effected. Thus in some West African tribes the mother has to remain in the hut in which she was delivered for a fixed number of days, or on a mud couch under which a fire is kept continuously burning.

Reference has already been made to the common practices of withholding the breast for the first three days, *i.e.* until colostrum is replaced by milk, the forcing of fluid or pap on the newborn, the universality of breast feeding and its duration, weaning habits, and the close mother-child relationship during early infancy. Where polygamy is practised, the older infant will very early become one of a group of younger children within the compound and a little later within the village. Whilst the tie to one or other parent remains (depending to some extent on whether the community is patrilineal or matrilineal), the child is very soon aware that he is part of a family group that is not limited to his parents, brothers and sisters. It is, for instance, quite common in some communities for a crying child to be picked up by any woman in the compound and given the breast as a comforter. If the mother dies during the child's infancy, he may be suckled by an aunt or grandmother, though sometimes there is a strong prejudice against such an 'ill-luck' infant and he will be allowed to die.

This conception of the extended family group, with its associated loyalties and taboos, is fundamental to the structure of unsophisticated societies, and is emphasised in the initiation ceremonies which commonly accompany the approach of puberty, betrothal, the payment of bride-price, and marriage. Where, as at present, the existing structure is liable to be broken by migration and detribalisation, formal education, or the impact of alien influences, there is a very real danger of a chaotic interregnum before fresh loyalties and responsibilities are firmly established.

The transition from 'primitive' to formal education is one which has potential dangers which must be clearly recognised if they are to be overcome. Thus the child in an unsophisticated community is primarily learning by direct imitation of his parents and elders, who are his teachers and whom he will admire for the possession of skills which he is anxious to acquire. The boy will be given by his father increasing responsibilities, *e.g.* herding, helping with house or canoe building, inclusion in fishing or hunting expeditions, whilst much of his play activity will be directed to fitting him to these ends. The girl will learn from her mother, and from an early age will be required to care for a younger baby, carry a pot of water balanced on her head, learn plaiting, grinding corn, cooking and the agricultural pursuits undertaken by the women of the tribe. Fortes (1938) who gave a detailed analysis of both play and economic activities among Tallensi children, found that the beginning of dichotomy in work and play was seen in the three to six year olds and that the dichotomy was well established by the age of twelve. Their whole education was thus directed to fitting them for the traditional occupations of men and women of their tribe.

With the introduction of formal education, the child no longer learns from the parents but from a professional teacher who is concerned with academic disciplines having little or no relationship to the customs of the child's home or tribe. He is acquiring skills which his father and elders probably do not possess, and which he may easily come to regard as superior to skilled craftsmanship or manual labour of any kind. If he returns to his own village, he may find himself a social misfit in the traditional structure of the community, unwilling to accept the authority of the elders and unfitted to take on the occupation of his father. As in any society, only a limited proportion of children will be really fitted to proceed to higher academic education, and there is at present an urgent need for the provision of technical education and apprenticeship.

It should be emphasised that these difficulties arising from the introduction of formal education apply essentially to the period of transition through which many of the tropical countries are passing, and will largely disappear when literacy had become general for more than a generation. This will, however, involve profound modifications in the whole structure of society and the period of change during which new disciplines are replacing the old is bound to cause some disharmony and discontent.

Although it is impossible to do more than illustrate a few of the innumerable ways in which native custom will affect child health, mention must be made of the vast subject of native 'medicine'. The word 'medicine' is often used rather loosely to cover both magical or religious practices and also forms of therapy based on the use of active drugs (the distinction not always being wholly clear even in temperate climates). In the underdeveloped areas of the tropics the great majority of children who now attend school (and almost all those who do not) will already have been brought in contact with deeply-held concepts of health and disease which are logically almost wholly irreconcilable with those of Western medicine. Thus a crocodile-infested water-hole may be preferred as a source of drinking water to a piped water supply on the grounds that the former increases fertility, or a well feared lest it should have pierced the vein of an underlying dragon; whilst almost every disease or calamity is liable to be attributed to the breaking of a taboo, the anger of Gods or demons, or the malevolent influence of a particular individual. It is against this background of early-childhood belief and training that the results of later education in health and hygiene must be viewed. Whilst many health projects have broken down from failure to discover or compromise with local belief or from the active hostility of native medicine-men, it is now almost equally common to find two opposing systems of medicine accepted simultaneously or consecutively. Where native medicine involves the propitiation of outraged deities or ancestors, or homoeopathic magic, and western medicine the use of chemotherapy, the patient may come to no harm in consequence of what might be described as psychosomatic treatment. But where, as is often the case, the armamentarium of the native practitioner includes drugs (usually of vegetable origin) with strong pharmacological action, *e.g.* emetics, purgatives, vermifuges, vesicants, and abortifacients, dual therapy may be lethal. Indeed, these active preparations themselves carry much greater risks in infancy and early childhood than in later life, owing to the entire lack of control of potency and dosage. The semi-mystical belief in the value of frequent purgation of small children is not, of course, limited to the tropics, but it is there more liable to initiate intractable and fatal diarrhoea: whilst the West African custom of treating infants with enemas (blown through a small calabash, and containing a variety of irritants) may produce sloughing of the rectum and gangrene. But although many native practices may be dangerous or disastrous, it is too common a mistake to dismiss 'native medicine' without attempting either to understand or evaluate it. It is salutary to remember that fashions come and go in Western medicine, which is still far from exact science, and that this applies particularly to the treatment of children. Within a generation, there has been a swing of the pendulum from the rigid 'by-the-clock' feeding of infants towards a 'feed-on-demand' schedule, which is the universal native practice; it is now being pointed out that much harm can be done to the young child by separating him from his mother during sickness, and the mother's aid in feeding and caring for him in hospital is being enlisted—again a principle that would be accepted as axiomatic in unsophisticated communities; whilst the recent development of the child guidance services in Europe and North America comes a tardy recognition of the very great need of treating psychological as well as physical sickness in childhood.

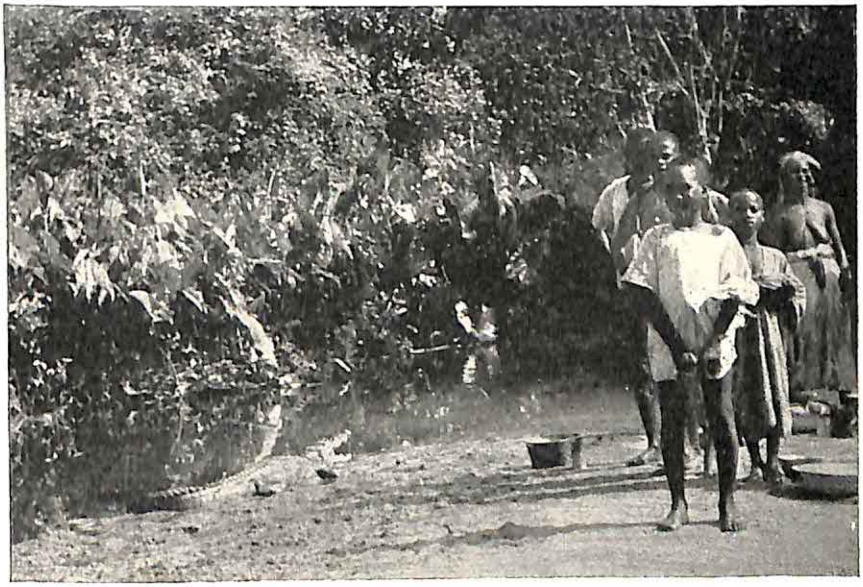


FIG. 89. Crocodile pool used for washing and drinking, and believed to increase fertility. On the left, a young crocodile lies asleep, undisturbed by the villagers (The Gambia).

Medicine, hygiene, nursing, agriculture and education in tropical countries are now to an increasing extent becoming the responsibility of those who, whilst themselves natives of these countries, have been trained in a European culture.

These workers are faced with the supremely difficult task of selecting what is fundamental and universally applicable in western civilisation, and distinguishing this from what is the result of purely local circumstance, economy and environment. On their success in applying essentials whilst retaining as much as possible of what is best in their own indigenous cultures will depend the future progress of their countries.

Infant and Child Health Services

The question immediately arises as to whether the structure of the child health services in Europe and North America is wholly applicable to tropical areas. Certainly the infant welfare centres and well-baby clinics, which have done so much to reduce infant mortality in the more advanced countries, are likely to serve to an increasing extent as training-grounds for personnel from the tropics, and a critical assessment of the value of each part of the structure is highly desirable before it is copied in any particular area.

Linkage of maternity and child-welfare services was in Great Britain a logical development in the early stages of the service and still emphasises the close interrelation of antenatal and postnatal care. With increasing specialisation in Great Britain, however, there has been a growing dichotomy between obstetrics and child welfare, and although the midwife is trained in care of the newborn she often has little experience of supervising the infant beyond this period. For midwives working in the underdeveloped areas the district-nurse-midwife might well serve as a model. A proper training in child welfare and some knowledge of disease in infancy and childhood is essential since the linkage between the two services is likely to remain a very close one, particularly in rural areas. The obstetric services in the tropics have in general tended to develop very much more rapidly than the paediatric, and there is a real danger of local midwife-training schemes neglecting the care of the older infant.

Infant welfare clinics. In considering the expansion of infant welfare services in the tropics, it should be clearly borne in mind that in Europe the need for infant welfare clinics and schools for mothers arose primarily from the widespread employment of women in industry and the consequent decline in breast feeding during the latter part of the nineteenth century. The French *Gouttes de Lait*, the English infant welfare centres, and the American well-baby clinics were all in the first instance designed to reduce the high infant mortality of artifically fed infants during the first twelve months of life. Indeed, the American movement was originally concerned largely with the provision of clean milk suitably modified for infant feeding at low cost. As the services have developed, the European clinics have attempted to encourage breast feeding (though after fifty years of propaganda less than 60 per cent of women in Great Britain breast feed their infant to the age of six months); 'safe' milk has been made generally available, and emphasis has been placed on the routine use of vitamin supplements in the prophylaxis of rickets and scurvy. In the case of breast-fed infants, weaning is usually recommended at six to nine months on the assumption that safe liquid or dried cow's milk will subsequently be available, and that appropriate mixed feeding can be given. The clinics have not been designed for the treatment of any except feeding disorders and minor ailments, again on the assumption that facilities for treatment of illness are readily available elsewhere.

In the tropics the position may be fundamentally different. Not only is breast feeding accepted as the normal procedure, at least in rural areas, but the supply of 'safe' cow's milk is often negligible. The deficiency diseases against which prophylaxis should be primarily directed are those prevalent in the particular area. Thus xerophthalmia, infantile beri-beri or kwashiorkor may be found to be a greater local hazard than scurvy, which is rare in the tropics and particularly so in breast-fed infants. Again, the medical services as a whole are not so comprehensive that 'preventive' clinics which do not undertake treatment are likely to be generally accepted or understood, at least at the present time.

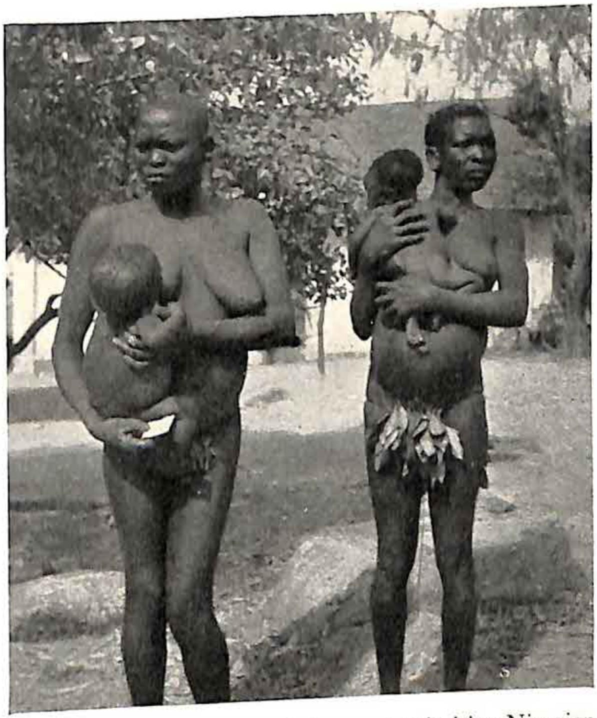


FIG. 90. Women of one of the most primitive Nigerian (pagan) tribes attending an infant welfare clinic (1953). When no clothes are worn, the infant is commonly carried on the hip or in a raw-hide sling on the back.

Clinics in a tropical area are most likely to be successful if the medical officer or nurse responsible is prepared to unlearn a considerable amount of the practice designed for European countries, and to make a detailed study of local conditions, including the staple diet and food prices. It appears unprofitable to concentrate too exclusively on the technique of breast feeding during the first months of life, when the age of introduction of mixed feeding, the technique, and a detailed consideration of the local foods available (though often not unutilised) and their preparation is of much greater importance. Early weaning from the breast (as distinct from the introduction of supplementary feeding) is apt to deprive the infant of a small but valuable supplement of protein during the first part of the

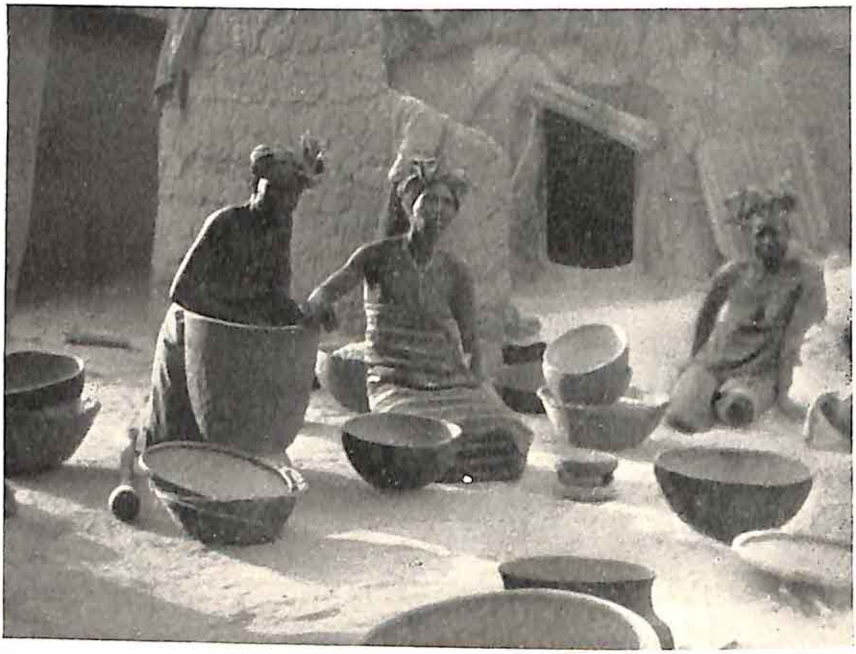


FIG. 91. Polygamous household (Northern Nigeria). The three wives have separate huts but share a common compound, where they remain in purdah. The children had, at the time of this photograph, been taken to the village infant welfare clinic by the father (see Fig. 92).

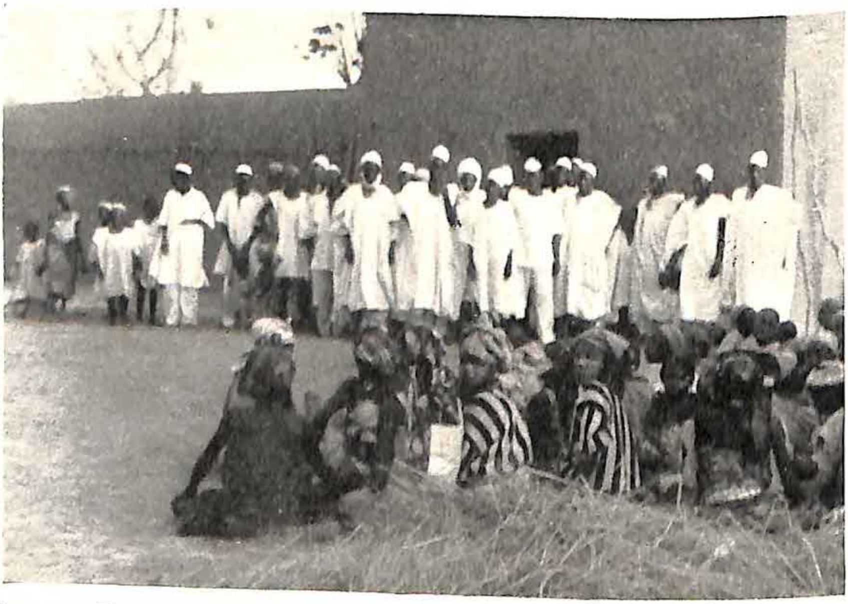


FIG. 92. Children and fathers at a children's clinic, the mothers remaining at home in purdah. Northern Nigeria.

second year. (It should also be remembered that in polygamous communities the nursing mother usually does not cohabit with the husband during lactation, and that if the infant is taken off the breast before the customary time a second pregnancy is likely to follow prematurely.)

The value of demonstrations of cooking and infant hygiene given to large groups of mothers in the clinic is greatly increased when these can be followed up by health visiting. Indeed, health visiting is probably the most valuable of all infant welfare activities, and though time consuming and extravagant of personnel it should be the aim to develop this service wherever possible. Enormous clinics alone are very apt to defeat their own object since infant welfare, more than any other branch of medicine, depends essentially on gaining the confidence and co-operation of the individual mother.

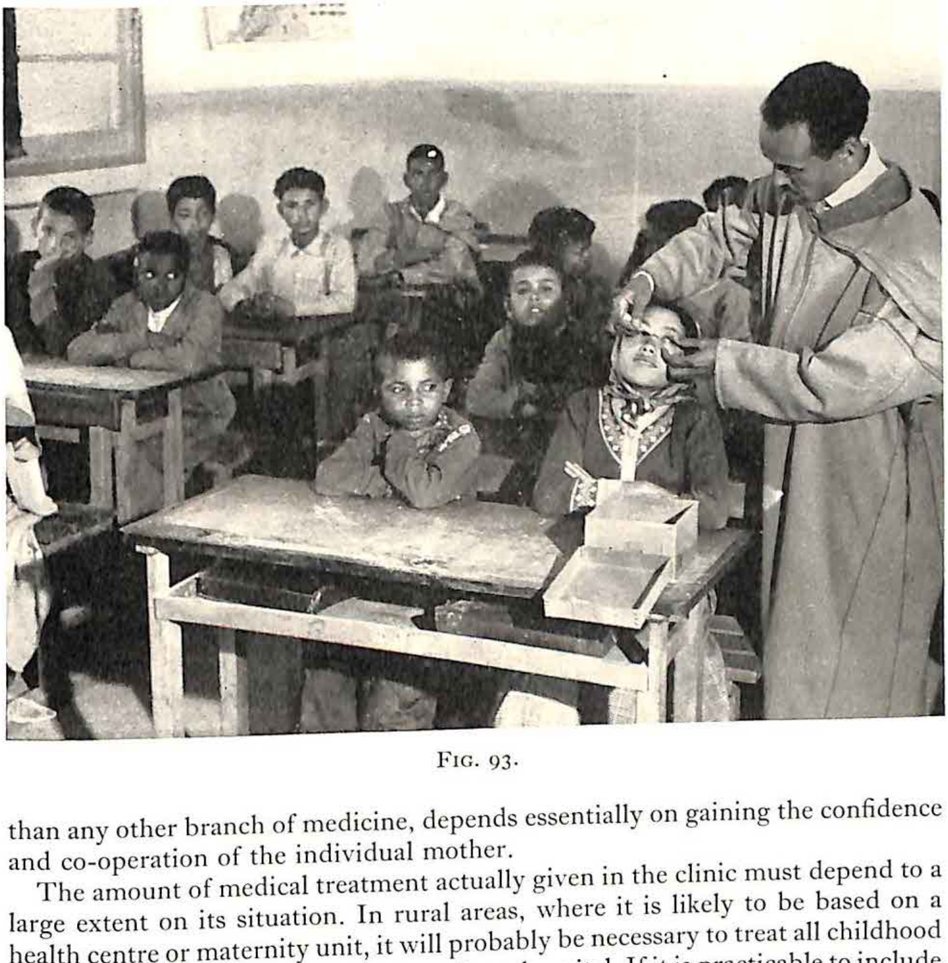
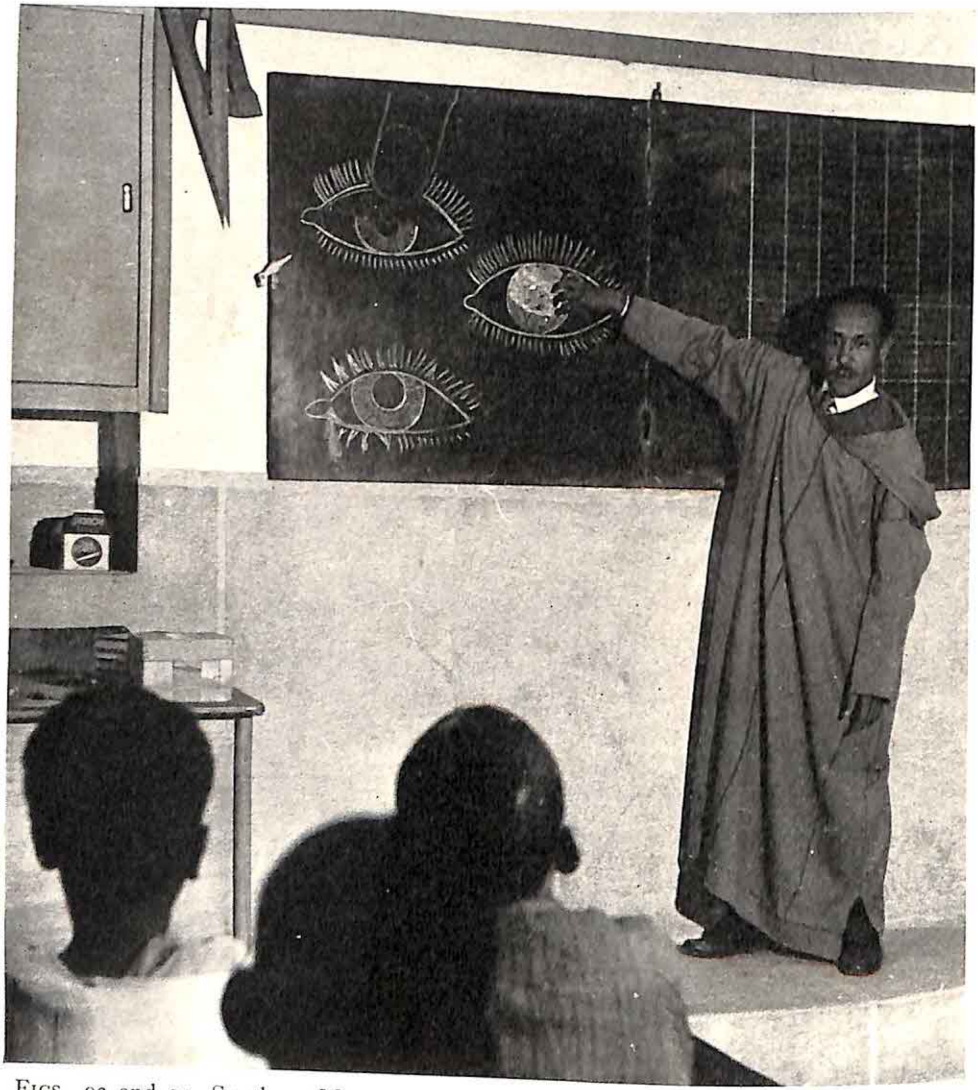


FIG. 93.

The amount of medical treatment actually given in the clinic must depend to a large extent on its situation. In rural areas, where it is likely to be based on a health centre or maternity unit, it will probably be necessary to treat all childhood ailments which do not necessitate transfer to hospital. If it is practicable to include a small number of 'observation cots' in such a unit, where sick infants can be retained during the day for observation, test-weighing, rehydration or treatment, it will be found that hospital admission can often be avoided and the mother instructed in home-care. Where the clinic is based on a hospital, and clinic tends to become a sieve for the out-patient department, minor treatments being given by the welfare sister whilst more severe ailments are passed on for medical care. It is only in the large urban areas, where hospital treatment is readily available elsewhere, that independent clinics devoted exclusively to prophylaxis and the teaching of mothercraft are likely to be found practicable. In some of these clinics, the attendance of older school-girls has been found valuable both in promoting health education and in recruiting helpers.



FIGS. 93 and 94. Southern Morocco. Health education and treatment of infective eye dieases are carried out in the village school. (From WHO Film 'Open your eyes'.)

Moslem communities will continue to provide a unique problem in infant welfare work so long as purdah is strictly observed. Whilst purdah-clinics held after dark may provide a partial solution, the extent to which they are used will depend largely on home visiting and persuasion. To clinics held during the day, infants are apt to be brought by sisters little older than themselves or by their fathers (Fig. 92). There is a great need for women medical officers and health visitors in Moslem areas, but often extreme difficulty in promoting female education and so recruiting trained personnel from the indigenous community.

The pre-school child. Whereas in Great Britain the child of two to five years is reached by a variety of agencies other than the infant welfare clinic, *e.g.* the general practitioner, health visitor, day nursery and nursery school, in many tropical areas almost all these are unavailable. Since this age group is highly vulnerable and often the most neglected, it is particularly important that welfare clinics should encourage attendance until the toddler is safely established on an adequate solid diet, and that mothers should be urged to bring up the older child for inspection when the new infant is born or at any time if the former is failing to thrive.

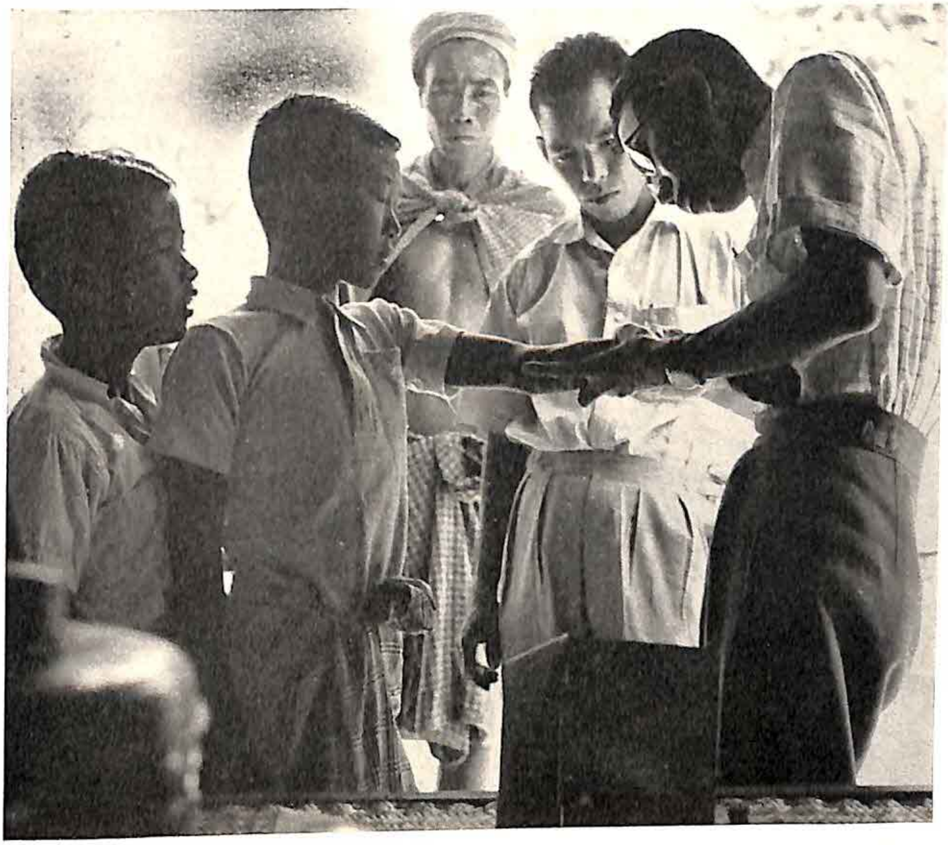


FIG. 95. Burma health assistant carrying out tuberculin test preparatory to BCG vaccination.

In some of the larger cities it is found that many three to five-year-olds are decanted on to the street when the mothers set off for market in the morning, and left with little food and no supervision until late in the day. Conditions here might be improved at relatively small cost by the institution of toddlers' playgrounds where small children could be left in safety, and some general supervision exercised.

School medical service. As a long-term policy, the general aims of the European school medical services are equally applicable to the tropics, *viz.* the provision of general inspection of all schoolchildren at intervals throughout their school life, consultation clinics for cases specially referred, reference of more severe disabilities to hospital, treatment of minor ailments, and health education. It would be unrealistic to minimise the difficulties of full achievement of these aims in rural areas, but the fact that an increasing number of children of school age are being brought into the educational system and are under the general supervision of adults whose teachers' training can and should include a modicum of health education, provides a structure through which the health of the schoolchild can to some extent be safeguarded. At the present time a great deal can be done through the teachers by giving them some instruction (including visual aids) in the recognition of diseases common in their area and by advice regarding diet. This latter applies particularly to residential schools, where economy or graft may result in the appearance of deficiency diseases.

The particular medical problems of the schoolchild will, of course, differ widely from those in England. Thus yaws or fungus infections of the skin may prove the major contagious condition in a particular area, whilst parasitic infestation or malaria may be so widely disseminated as to represent an almost universal hazard.

In general, although the health and physique of schoolchildren often compare very favourably with those of the youngest age groups, the schools have a most important part to play in improving standards of hygiene, *e.g.* in teaching the use of latrines, the dangers of infected water, the necessity for early treatment of infectious disease, and indirectly in improving diet. Thus one of the major problems of the tropics is the alternation of 'fat and lean periods' corresponding with wet and dry seasons. In residential schools a more or less consistent diet is possible throughout the year, and in day-schools where it is a common practice for children to obtain a mid-day snack from street traders, the type of food sold can be supervised and improved (Wilson, 1954*b*). Even the provision of a mid-day school meal at cost price has been found practicable in some day-schools, and this beginning of a school meals service offers immense possibilities.

The Future

With regard to the control of disease, there is good reason to hope that large areas of the tropics will, within a relatively short time, be cleared of many of the diseases which have held back their development for centuries. It has been pointed out (Chaudhuri, 1954) that many so-called 'tropical' diseases, *e.g.* plague, cholera, dysentery, leprosy, malaria, yellow fever and smallpox, flourished in Europe or North America at no very remote date. With the vastly improved modern methods of attack, the difficulties, though great in tropical areas, are not insuperable, provided that the peoples of the countries concerned are firmly convinced of the importance of the undertakings. This is a large proviso, but the Indian Five Year Plan is already showing what can be done when major schemes have the backing of the electorate and the support of the World Health Organisation and the United Nations International Children's Emergency Fund. Thus parts of India, which had been abandoned to jungle a thousand years ago on account of malaria, have not only been cleared of malaria but are rapidly being brought under cultivation with the aid of the Food and Agriculture Organisation. Tuberculosis, though still one of the major killing diseases of tropical areas, is being attacked as a world problem. BCG vaccination programmes have been carried out in sixty-four countries with the assistance of WHO, UNICEF and ITC, and represent one of the largest international health programmes of the century. By the end of 1959, 265·4 million tuberculin tests and 105·7 million vaccinations had been effected.

Many other examples in different parts of the tropics could be cited. But the bleak fact remains that control of disease leads rapidly to increase in population, and that productivity must increase even more rapidly if the present low standards of living are to be effectively improved.

Little has been said here of the great amount that has already been done in tropical countries—the building of modern hospitals, clinics, schools, technical colleges and universities, or the real progress that has been made in agriculture. It would have been equally possible, though perhaps more misleading, to draw illustrations entirely from these sources. But the major child health problems of the tropical areas lie not amongst that minority of children who are receiving education, diet, and medical attention of high quality, but amongst the great majority who are not. (It should be emphasised that the distinction is not altogether one of urban versus rural populations, since in many of the larger cities the living conditions in the slums are very much worse than in most villages; nevertheless the social services tend to be concentrated in the more densely populated areas, and the remoter areas have often remained remarkably primitive.) The present picture is one of extreme contrasts—some of the existing institutions being more than a thousand years in advance of cultures existing side by side. The child who is required to hurdle over the centuries in a single lifetime, reaching a modern university from a primitive village community and from there going on to shoulder responsibilities of democratic government or administration which call for integrity, vision, and balanced judgment, is being faced with a phenomenally heavy task. It is not surprising that there have been failures, but rather that successful progress has already been so great.

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Chapter 23

FAMILY PLANNING

In good obstetric practice the first aim is to secure for each mother a healthy baby after an uncomplicated pregnancy and labour whilst the paediatrician's concern is that the child should develop normally and achieve its full potential as a useful citizen. But these objectives cannot be attained simply by sheer excellence in medical care. So much depends on the individual husband and wife and on the standards they set in their own lives and in their own homes. Where health is good and the environment favourable the mother can rear a succession of healthy children but the opposite, too often, is true. Where parents especially in the lower socioeconomic groups are apathetic or indolent and unable or unwilling to take any initiative over birth control a large family adds considerably to their difficulties. In their study of 1,000 families in Newcastle upon Tyne, Spence *et al.* (1954) drew attention to the relationship between high parity and problem families. The average number of children within a group of problem families was 4·3 compared with 2·3 for the remainder. The children in these families had one and a half times the expected number of illnesses and twice the incidence of bronchitis and pneumonia. The inability of such families to control their rate of reproduction is a major problem in so much as these parents and their numerous offspring are a considerable burden on the various social and medical services. In general it is women in the lower social groups who have large families and it is these mothers who contribute heavily to the wastage of child life at birth. The effect that these mothers can have on perinatal mortality in large communities has been shown by Russell *et al.* (1963) who have compared the Cities of Newcastle upon Tyne and Aberdeen. Perinatal mortality is lower in Aberdeen (Fig. 96) and Russell and his colleagues have shown (Tables 21–23)

Table 21

Perinatal Mortality by Social Class in Aberdeen (1959–60) *and Newcastle* (1960): *Single Legitimate Births Only*

	Aberdeen				Newcastle			
Social class	No.	Per-centage in each S.C.	Peri-natal deaths	Peri-natal mor-tality	No.	Per-centage in each S.C.	Peri-natal deaths	Peri-natal mor-tality
I + II	899	14·4	24	26·7	654	13·9	16	24·5
III	3730	59·8	115	30·8	2867	60·9	82	28·6
IV + V	1592	25·5	49	30·8	1115	23·7	50	44·8
Total*	6242	100·0	188	30·1	4711	100·0	154	32·7

* Totals include cases in which social class was not stated.

TABLE 22

Incidence of Grand Multiparity by Social Class in Aberdeen (1959–60) *and Newcastle* (1960): *Single Legitimate Births Only*

	Aberdeen 1959–60			Newcastle 1960		
Social class	Total deliveries	Grand multiparas	Percentage grand multiparas	Total deliveries	Grand multiparas	Percentage grand multiparas
I + II	899	41	4·6	654	52	8·0
III	3730	278	7·5	2867	349	12·2
IV + V	1592	243	15·3	1115	275	24·7
Total*	6242	572	9·2	4711	686	14·4

* Totals include cases in which social class was not stated.

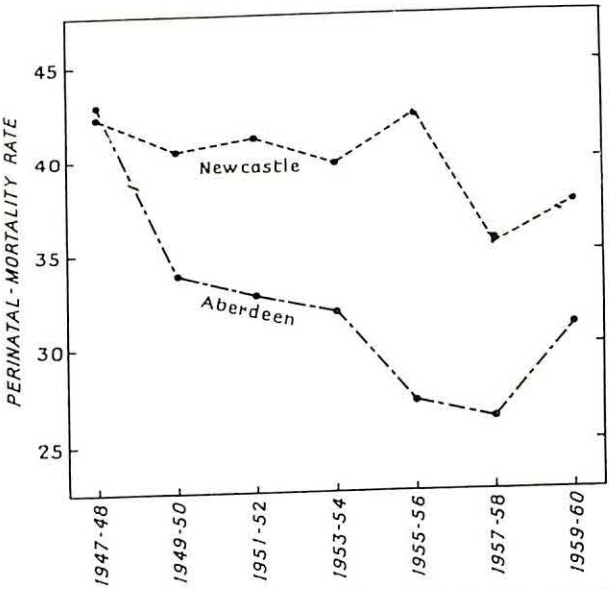

FIG. 96. Perinatal mortality rates in the City of Newcastle upon Tyne and in the City of Aberdeen 1947–1960.

that were it not for the very high rate (87.3 per 1,000 births) among 275 grand multipara in the lowest social classes Newcastle would lose fewer babies at birth than Aberdeen.

Inefficiency in reproduction and inability to care properly for young children are two obvious reasons for family limitation, but there are other circumstances which make it advisable to restrict the number of pregnancies. Some mothers whose health is excellent and who have the best of medical attention give birth

TABLE 23

Perinatal Mortality in Grand Multiparas by Social Class in Aberdeen (1959–60) *and Newcastle* (1960): *Single Legitimate Births Only*

	Aberdeen 1959–60			Newcastle 1960		
Social class	Total grand multiparas	Deaths	Perinatal-mortality rate	Total grand multiparas	Deaths	Perinatal-mortality rate
I+II	41	0	0	52	2	38·5
III	278	14	50·4	349	17	48·7
IV+V	243	11	45·3	275	24	87·3
Total*	572	25	43·7	686	44	64·1

* Totals include cases in which social class was not stated.

to children who are severely afflicted by some inherited disability. An obvious example is Rhesus incompatibility where one hydropic stillbirth may follow another and little if anything can be done to secure a living child for the mother. It is important here for obstetricians and paediatricians to work in the closest harmony and to keep a sense of balance. It would seem reasonable at least once to try premature induction of labour or possibly intraperitoneal blood transfusion (Liley, 1963) at the 28th or 30th week whilst the foetus is still in utero. But there comes a time when common sense should lead the patient's medical advisers to suggest that further pregnancies should be avoided.

Where there is a family history of such conditions as phenylketonuria, cystic fibrosis of the pancreas or osteogenesis imperfecta parents may well want to know about the advisability of further pregnancies. On the whole those who seek advice in this way are the more intelligent and articulate members of society. The real problem is to reach the others who go on reproducing and adding to their own personal difficulties and to those of the community in which they happen to live. Rather than stand aside and watch this happen it would seem preferable for family doctors and paediatricians to take the initiative and discuss the question of further pregnancies with these parents who mostly welcome advice and help offered in this way.

In the wider field, at national level, rapid expansion of population is probably the most urgent problem facing many countries throughout the world today. In his Sir John Morris Memorial Lecture, Macfarlane Burnet (1961) speaking as a biologist, reminded his audience that preventive medicine has greatly reduced the number of deaths from infectious disease and malnutrition. Yet in some ways this very success has produced two major biological difficulties—over-population and genetic deterioration. The solution of these two problems will tax all our powers in the future. Again a recent report on the growth of world population published by the National Academy of Sciences (1963) describes the situation simply, bluntly and effectively 'All nations are committed to achieving a higher standard of living for their people—adequate food, good health, literacy, education and gainful employment. These are the goals of millions now living in privation. An important barrier to the achievement of these goals is the current rate of population growth. The present world population is likely to double in the next thirty-five years, producing a population of six billion by the year 2000. . . . Such rapid population growth, which is out of proportion to present and prospective rates of increase in economic development, imposes a heavy burden on all efforts to improve human welfare. . . . It is an international problem from which no one can escape. . . . In our judgement this problem can be successfully attacked by developing new methods of fertility regulation, and implementing programmes of family planning widely and rapidly throughout the world . . . the problem of population growth can no longer be ignored. . . . Other than the search for lasting peace, no problem is more urgent. . . . The over-all task is to achieve universal acceptance of the desirability of planning and controlling family size. An essential condition for the achievement of this objective is the awareness among people throughout the world that voluntary planning and control of family size can and will provide better opportunities for all children and greater happiness for their parents.'

There is growing recognition that parents have a right, indeed an obligation, to plan their families and that health, especially maternal and child health, is to a great extent dependent upon reliable and sensible family planning. There are many ways of controlling fertility but no single method is universally applicable or even acceptable. Coitus interruptus where the husband withdraws before ejaculation is probably the commonest practice but not a very reliable one. Among the less well educated it undoubtedly plays some part in controlling family size. Most gynaecologists believe that this form of intercourse can give rise to chronic pelvic congestion in the female and to symptoms such as dysmenorrhoea and dyspareunia. They advise against it. The rhythm method of fertility control has received a great deal of publicity. In theory at least, there is less chance of conception if intercourse takes place only during the 'non-fertile' period just before and after menstruation. In fact few women have a completely regular cycle (colds, infections and emotional disturbances can delay ovulation) and the method is not reliable. Contraceptive appliances such as sheaths and occlusive pessaries (used with spermicidal creams) are more reliable but their regular use demands a fair degree of persistence and intelligence. These techniques are used effectively by the more sophisticated sections of Western societies.

But what of the less well educated in our own and in other European communities and the mass of the population in developing countries throughout the world? What practical methods of family planning are available to them? Unfortunately the very poor, who are in general the most fertile, are the people who are most reluctant to make use of available facilities for birth control. In our own country their special problem has been studied by Dr. Dorothy Morgan (1964) in Southampton and Dr. Mary Peberdy (1964) in Newcastle upon Tyne. In both centres a domiciliary birth control service has been established for problem parents who either will not or cannot attend family planning clinics. In three years up to August 1964, Dr. Morgan successfully converted 150 families to the use of contraception. This is a considerable achievement for many were of low intelligence and some were registered mental defectives. Among these 150 families there were 142 births in the two years before the service began; in the following two years the number of births fell to 32. Mechanical forms of contraception were used initially but now oral contraceptive tablets are the most favoured form of birth control among these families. Dr. Peberdy's experience in Newcastle upon Tyne has been much the same as Dr. Morgan's in Southampton. Both emphasise the need to regard birth control as a joint responsibility affecting husband and wife who should be interviewed together. These local experiments show what can be done by tact and persistence and of course the problem has been eased by the advent of the contraceptive pill. There is now little doubt that progestogen-oestrogen mixtures are highly efficient contraceptive agents but their safety is still disputed and will not be proved for at least twenty years and probably longer. Dodds (1961) has reviewed the history of pituitary suppression and has sounded a warning about the unrestricted use of hormones for this purpose. It is important to balance possible risks against advantages. In advanced countries where a variety of other methods of birth control are available and acceptable to large numbers of the population it would seem wise to restrict the use of oral contraception to those who find other ways of family limitation impossible or ineffective. Where widespread undernutrition, starvation and disease are immediate and more important threats than possible future ill health for a few then the advantages of oral contraception may well outweigh theoretical hazards such as permanent changes in the pituitary or the development of cancer and the undoubted tendency to increase the risk of thrombosis.

Other methods of oral contraception are under active investigation and in the near future it is likely that some new preparation with less profound effect on the endocrine system will prove to be effective and acceptable. It has been known for the past ten years that certain compounds of the nitrofuran and thiophene type can halt spermatogenesis at the primary spermatocyte stage and that this action is completely reversible; the action is not through the endocrine system. Unfortunately these drugs inhibit secretion of male sex hormone and reduce libido and in their present form are unacceptable as contraceptives. More promising are the dinitropyrrole group of compounds one of which is particularly effective in blocking spermatogenesis in the rat. A single oral dose is effective for four weeks. In a recent paper Szent-Gyorgyi *et al.* (1963) report the isolation of a substance 'infertine' from the calf thymus; when administered to adult mice it causes temporary infertility. In time these important developments may have a practical application in the control of human fertility.

The revival of an old method of birth control—the insertion of a foreign body into the uterine cavity—has attracted a great deal of interest in the past few years. It is thirty-five years since Grafenberg (1930) reported the use of gold and silver rings for this purpose though complications, chiefly infection, prevented the widespread acceptance of this practice. But the situation has changed. Antibiotics are now available and various devices made of plastic or of stainless steel are said to be less irritating than gold or silver. The stimulus has come from workers in Israel (Oppenheimer, 1959) and Japan (Iskihama, 1959) and already governments in Tunisia, Pakistan and South Korea are offering this form of family limitation to their population (Lancet, 1964). For these countries and for problem families in our own communities the intra-uterine contraceptive device has many advantages. It is cheap and once it has been successfully inserted and retained the patient is protected against pregnancy without requiring to do anything more (compare this with the need to take a contraceptive pill each day or fit an appliance each time intercourse takes place). In about 20 per cent of cases the device either falls out or has to be removed because of pain, bleeding, infection or because of the husband's objection. There is, however, no threat to life and these disadvantages must be weighed against the dangers which in many countries are still associated with a rapid sequence of pregnancies. For the 80 per cent who retain the coil or loop it appears to be a highly successful means of avoiding pregnancy and the newer devices can be left in position for years provided there are no untoward symptoms. It is estimated that the risk of a pregnancy is between two and five per 100 years of exposure (Lancet, 1964). From work already done it is evident that these devices work in different ways in different species. In monkeys there is rapid discharge of ova from the fallopian tube whilst in cattle ovarian function is affected. Pincus (1964) suggests that in man the devices work by inducing hyperoestrinism. It is certain that they do not act by dislodging a fertilised ovum that has already implanted in the endometrium. For those who agree with the working party of the British Council of Churches (Report, 1962) that nidation is the beginning of human life there should be no religious scruples about using this method of birth control. In time the intra-uterine device may become one of the common methods of controlling fertility and it is likely to prove especially useful in developing countries faced by rapid expansion of population.

Both oral contraception and intra-uterine devices are associated with certain risks but these must be measured against pregnancy complications and particularly against the hazards of procured abortion. We remain ignorant of the true extent to which pregnancies are deliberately terminated by abortion but there is no doubt that this is an important cause of maternal death in the United Kingdom and throughout the world. The most recent report (Min. of Health, 1963) on Confidential Enquiries into Maternal Deaths in England and Wales (1958–1960) records that during the three-year period 135 maternal deaths were directly due to abortion; there was evidence that 82 of these deaths (61 per cent) were criminal abortions. These 135 deaths constitute 18 per cent of all maternal deaths in England and Wales during 1958–1960. In New York City the proportion of maternal deaths associated with abortion (mostly illegal) was 43·8 per cent in 1962 (W.H.O., 1963). These figures give some idea of the formidable toll exacted by unwanted pregnancies.

The diagnosis and management of pregnancy complications and of illness in the young occupy so much of the time of obstetricians and of paediatricians that it is quite possible for them to forget that some at least of the problems that beset parents and their young children could be avoided by efficient birth control. To some extent this is a reflection on undergraduate teaching for marital problems including sex education and the various techniques of birth control receive scant if any consideration in most medical schools. Nor is sufficient attention paid to the many sociomedical factors which can have such a profound influence on reproductive efficiency and on the health of young children. Small wonder that doctors generally are ill-informed and ill-equipped to advise parents who need help. The time is opportune to remedy this defect in the training and practice of doctors.

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Appendix

SYNOPSIS OF LEGISLATION

REGISTRATION OF BIRTHS, STILLBIRTHS AND DEATHS.
NOTIFICATION OF BIRTHS.
CHILDREN AND YOUNG PERSONS ACTS, 1933–63.
CHILDREN AND YOUNG PERSONS (SCOT.) ACTS, 1937–63.
CHILDREN ACTS, 1948, 1958.
MATRIMONIAL PROCEEDINGS (CHILDREN) ACT, 1958.
ADOPTION ACTS, 1958, 1960.
NURSERIES AND CHILD-MINDERS REGULATION ACT, 1948.
CONSUMER PROTECTION ACT, 1961.
FAMILY ALLOWANCES ACTS, 1945–59.
EDUCATION ACTS, 1944–53.
EDUCATION (SCOT.) ACT, 1962.
EMPLOYMENT AND TRAINING ACT, 1948.

This synopsis of legislation dealing with various aspects of the child is designed to give a broad picture of the most important relevant Acts. For details the reader must refer to the original Acts.

Registration of Births, Stillbirths and Deaths

ENGLAND AND WALES. THE BIRTHS AND DEATHS REGISTRATION ACT, 1953. (*a*) Each live birth must be registered within forty-two days of its occurrence with the registrar of the registration sub-district in which it occurs. (*b*) The Registrar-General may order the re-registration of the birth of a person whose birth has been registered as illegitimate on the subsequent marriage of the parents whatever their status at the time of the birth (Legitimacy Acts, 1926–59). (*c*) Each stillbirth must be registered as for a live birth but, under the Population (Statistics) Act, 1960, the person giving information to registrar must deliver to him a certificate, giving the cause of the stillbirth and the estimated duration of pregnancy, signed by a registered medical practitioner or qualified midwife, or make a declaration that the infant was stillborn and neither doctor's nor midwife's certificate could be obtained. (*d*) Each death must be registered within five days of its occurrence.

SCOTLAND. THE REGISTRATION OF BIRTHS, DEATHS AND MARRIAGES (SCOT.) ACTS, 1854–1938. (*a*) Each live birth must be registered within twenty-one days of its occurrence with the registrar of the registration district in which it occurs. (*b*) An illegitimate birth, registered by the mother, may be re-registered as legitimate after application to the Registrar-General for Scotland but re-registration can only take place if both parents were free to marry at time of conception of child (cf. English position under Legitimacy Acts). (*c*) Procedure relating to stillbirths similar to that in England and Wales, save that certificate of cause of stillbirth has been required since 1939. (*d*) Each death must be registered within eight days of its occurrence.

Notification of Births

ENGLAND AND WALES. THE PUBLIC HEALTH ACT, 1936. The original Notification of Births and Notification of Births (Extension) Acts were repealed by and incorporated in the above Act. Every birth, live or still, must be notified, on a prescribed form to the medical officer of health of the area in which the birth occurred, by the father if residing at the house at the time of the birth, and by any person in attendance upon the mother at the time of or within six hours of the birth. The notification must be made within thirty-six hours after the birth. In practice, notification is invariably made by the doctor or midwife, who is supplied with appropriate notification of birth cards for his or her use by the local public health department.

SCOTLAND. THE NOTIFICATION OF BIRTHS ACT, 1907, and THE NOTIFICATION OF BIRTHS EXTENSION ACT, 1915. The original Acts are still in force in terms the same as contained in the Public Health Act, 1936.

N.B. In both England and Scotland, no birth is required to be notified if the duration of pregnancy was less than twenty-eight weeks, but the birth of a live-born child must be registered regardless of the duration of pregnancy.

A stillbirth is 'any child which has issued forth from its mother after the twenty-eighth week of pregnancy and which did not at any time after being completely expelled from its mother breathe or show any other signs of life.'

Acts Relating to the Protection of Persons under Eighteen Years

ENGLAND AND WALES. THE CHILDREN AND YOUNG PERSONS ACTS, 1933–63. The principal Act is that of 1933, amended and supplemented by Acts of 1938, 1952, 1956, and 1963, and other Acts. A 'child' is any person under fourteen years; a 'young person' is one over fourteen but under seventeen years.

Welfare powers of local authorities. This section, introduced by the 1963 Act, requires a local authority, through its children committee, to make available such advice, guidance, and assistance including in exceptional circumstances cash, as may promote the welfare of children, in this section defined as those under eighteen years, by diminishing the need to receive them into or keep them in care or to bring them before a juvenile court. To achieve this a local authority may make arrangements with voluntary organisations with such facilities for advising, guiding and assisting. Local authority must report to Secretary of State annually on provisions made for these facilities.

Prevention of cruelty and exposure to moral or physical danger. It is an offence wilfully to neglect or ill-treat a child or young person under sixteen, in a manner likely to cause suffering or injury to health. Provision is made against: seduction of girls under sixteen; residence of persons under sixteen in brothels; causing persons under sixteen to beg; giving intoxicating liquor to children under five (except for medicinal purposes); the presence of children under fourteen in the bars of licensed premises; the sale of tobacco to persons under sixteen; acceptance of pawns or purchases of old metal from the young; exposing children under twelve to risk of burning; failure to provide for safety of children at entertainments.

Employment. It is illegal to employ any child under thirteen. Hours of employment of older children are limited within certain hours of the day. No child shall be employed to lift, carry or move anything so heavy as to be likely to injure him. No person under seventeen can engage or be employed in street trading, and no person under eighteen can take part in street trading on Sundays save under stated conditions. Any person under sixteen taking part in an entertainment for which a charge is made, or film or broadcast, must be licensed to do so by the local authority; a child under thirteen may be licensed to perform in an entertainment under strictly limited conditions, *e.g.*, the part he is to act cannot be taken except by a child of about his age. Local authority empowered to license those who are between twelve and sixteen and being trained for performances of a dangerous nature.

Protection of children and young persons in relation to criminal and summary proceedings. Charges against children and young persons are heard at specially constituted juvenile courts, to the proceedings of which the general public are excluded but accredited newspaper reporters are permitted to attend. No newspaper report of any proceedings in a juvenile court may include any information or pictures which may lead to the identification of any child or young person, a protection which is also extended to a child or young person concerned in proceedings in any other court and the protection covers sound and television broadcasts. A parent or guardian may be required to attend at court when a child or young person is brought before it. No child under ten can be charged with an offence. Any offence of which a person was found guilty while under fourteen years of age shall be disregarded in any charge made against him when he is twenty-one years or over. A child or young person found guilty of an offence may be dealt with by the court in various ways, including committal to an approved school which must be specified by the Secretary of State, or to the care of a 'fit person', detention in a remand home or detention centre, supervision under a probation order, fine, or attendance at an attendance centre. Certain of these forms of judgment are available only for specified age groups.

Any person may give information, on oath, to a magistrate that a child or young person is being assaulted, ill-treated or neglected in a manner likely to cause him unnecessary suffering or injury to health, or that one of a specified list of offences has been committed in respect of him. If satisfied, magistrate may issue a warrant to a constable to seek out and remove child or young person to a place of safety and the child or young person must be brought before a juvenile court within twenty-eight days of his removal unless he is released or received into the care of a local authority.

A child or young person is said to be in need of care, protection or control when he is not receiving such as a good parent may reasonably be expected to give, or is beyond the control of his parent. Conditions constituting need for care, protection or control are: he is falling into bad associations or is exposed to moral danger; or, the lack of care, protection or guidance is likely to cause him unnecessary suffering or seriously to affect his health or proper development; or, certain specified offences have been committed against him or against any child or young person in the same household; or, he is a member of same household as a person who has been convicted of an offence against a child or young person; or, the child or young person is a female member of a household one of whom has committed or attempted to commit a penalisable sexual offence. Parent or guardian cannot himself bring a child or young person before a juvenile court on grounds that he is beyond parents' control, but must request in writing the local authority to do so and the authority must proceed within twenty-eight days of request or may refuse to take any action, in which case parent may apply to court for an order directing authority to do so. Court may require the local authority to make available to it information as to home conditions, school record, health and character of the child or young person concerned. When court hears complaint that a child or young person is beyond control, he shall not be present. A local education authority may bring a child or young person before a court for persistent truancy from school and he may be dealt with in same manner as child or young person found to be in need of care, protection or control, *i.e.* sent to an approved school specified by the Secretary of State; committed to the care of a 'fit person'; parent or guardian enters into a recognisance to exercise proper control and guardianship; supervised by a probation officer or other person appointed by the court. It is a duty of parent to notify any change of address to approved school or fit person.

Remand Homes, Approved Schools. Remand homes must be provided by county and county borough councils to which children and young persons may be sent by a court on remand or as a place of safety. 'Special reception centres' may be set up for the custody on remand of any child under fifteen so as to avoid sending him to a remand home. Conduct of remand homes governed by rules made by Secretary of State and they are inspected by Children's Department of Home Office.

An approved school is a residential school approved by the Secretary of State for the education and training of boys or girls. A court may order removal of a boy or girl to an approved school but the Secretary of State must specify to which school he or she is to be sent. Local authorities or voluntary managing bodies may provide such schools which are classified according to age and sex of persons for whom intended, their religious persuasion, and the character of the education and training given. The schools are used exclusively for the accommodation of those who have been committed for having committed offences, being beyond control, in need of care, protection or control, and persistent truancy. No person may be detained in an approved school beyond his nineteenth birthday. The Secretary of State may designate a remand home as a classifying centre for persons sent to an approved school and for certain purposes such classifying centre must be treated as an approved school. The school managers are required to undertake after-care of every person leaving school but they may request local authority to do so and authority must undertake this after-care.

Research. Secretary of State and local authorities are empowered to undertake research in matters pertaining to these and other Acts, including the Children Act, 1948, and Adoption Acts.

SCOTLAND. THE CHILDREN AND YOUNG PERSONS (SCOT.) ACTS, 1937–63. There are several differences in the provisions of these Acts compared with those operative in England and Wales. Some of the more important differences include: a child under eight cannot be charged with an offence; it is an offence to expose a child under seven to risk of burning. Any reference in the Acts to the Secretary of State means in Scotland a reference to the Secretary of State for Scotland. Provision is made for the arrest in any part of the British Islands of children or young persons escaping from another part.

SCOTLAND, ENGLAND AND WALES. (*a*) CHILDREN ACT, 1948, as amended by the Children and Young Persons Act, 1963. The Act makes further provision for the care or welfare, up to the age of eighteen, and, in certain cases, further periods, of boys and girls when they are without parents or have been lost or abandoned by, or are living away from, their parents, or when their parents are unfit or unable to take care of them, and in certain other circumstances. With certain differences in detail, the principal Act as amended is applicable to Scotland, England and Wales.

It is the duty of a local authority to receive into its care any child under seventeen, who is without parents or guardian, has been abandoned or lost, or whose parents or guardian are prevented, permanently or temporarily, from providing him with a normal home life, provided that the intervention of the local authority is deemed necessary in the interests of the child. The duty to receive such a child is placed on the local authority in whose area the child is found, but the local authority of area of his domicile may receive the child or provide for his maintenance. The local authority must look after the child till he is eighteen, if his welfare so demands, but must return him to his parents if they so desire and if this is in the interests of the child, or if the authority can arrange for his care by parents, relatives or friends.

A local authority may, in respect of any child already in its care, by resolution assume parental rights if his parents' or guardians' whereabouts remain unknown for at least twelve months; or he suffers from any mental disorder rendering him unfit to care for the child; or he has persistently failed without reasonable cause to discharge obligations of a parent or guardian as to be unfit to have care of child. If parent or guardian objects he can apply to court. It is an offence to harbour or conceal a child in care of a local authority after its assumption of parental rights. Under the Children and Young Persons Acts, a court may prescribe the most suitable means of caring for a child (in case of a child brought before it) and the local authority must act as a 'fit person' for such care if so required unless child is subject to probation or supervision.

A local authority must provide suitable accommodation for the children in its care either in homes provided by it or in voluntary homes when boarding-out is impracticable or undesirable. Secretary of State empowered to make regulations concerning foster-parents, homes, hostels, etc., and concerning accommodation, equipment, medical care, and religious instruction. The Secretary of State for Scotland is similarly empowered. Hostel accommodation may also be provided by a local authority for persons over school age and under twenty-one, or longer if necessary, where such persons have been in the care of the local authority. Financial aid may also be given by an authority for the education and training of persons between seventeen and twenty-one when such persons had been in the care of the local authority at the age of seventeen. Similarly, local authority may visit, advise and befriend any person who so desires this and who was in the authority's care up to the age of seventeen.

Parents, putative father, or mother are liable to make financial contributions towards a child's care up to sixteen. Thereafter, if the child is in wholetime adopter(s) but in England this automatic inheritance does occur save in case of titles, etc.

Adoption societies, which must be voluntary bodies, must be registered with local authority which is entitled to inspect their books. Regulations govern conduct of adoption societies. Local authorities are empowered to make and participate in adoption arrangements whether infants in the care of the authorities or not.

Child placed with a view to his adoption is called a 'protected child' and is (i) one under school leaving age who is placed (for adoption) by a stranger (or third party) with a person who is not a parent, guardian or relative of child, or (ii) one for whom notice of intention to apply for an adoption order has been given to local authority. Protected children supervised by local authority under provisions similar to those obtaining for foster-children under Children Act, 1958, and these provisions apply until either (*a*) adoption order is granted in respect of a protected child or (*b*) he attains eighteen years, whichever first occurs.

Under Adoption Act, 1960, where any person legitimated under Legitimacy Act, 1959, had been adopted by his father and mother before that Act became operative, the court granting the adoption order may, on application by any of the parties concerned, revoke the order. (England only.)

Nurseries and Child-Minders

NURSERIES AND CHILD-MINDERS REGULATION ACT, 1948. An Act to provide for the regulation of certain nurseries and of persons who for reward receive children into their homes to look after them. Act applicable to Scotland, England, and Wales.

Nurseries. Premises, not wholly or mainly used as private dwellings, where children are received to be looked after for the day or a substantial part thereof or for any longer period not exceeding six days.

Child-minders. Persons who for reward receive into their own homes children under the age of five to be looked after for the day or a substantial part thereof or for any longer period not exceeding six days.

A local health authority must keep registers, open to public inspection, of all premises and persons (nurseries and minders) in its area. Any person proposing to receive children as defined under nurseries and minders must apply for registration to the local health authority. The authority may specify the maximum number of children to be admitted and require that precautions be taken against exposure of the children to infection. Requirements may also be imposed regarding—the qualifications and experience of the person in charge of the children; the adequacy of the staff; the repairs and alterations to premises which may be required; the equipment required and its maintenance; the adequacy of feeding arrangements and dietary; the medical examination and supervision of the children; the keeping of proper records.

A child-minder, not a relative, and receiving more than two children under five from more than one household must be registered, but one receiving two children from one household does not require to be registered.

Certificates of registration must specify situation of premises to which, or the name and address of the person to whom, the registration relates and any requirements imposed by the authority. Any change of circumstances must be reported to the authority. There is power to refuse and cancel registrations. Authorised persons have power of entry to premises. Schools and nursery schools provided by local education authorities or assisted by them, hospitals, and premises where child life protection enactments apply, are exempted from registration under this Act.

Protection of Heating Appliances, etc.

CONSUMER PROTECTION ACT, 1961. An Act to make provision for the protection of consumers. It supersedes the Heating Appliances (Fireguards) Act, 1952, and the Oil Burners (Standards) Act, 1960, but regulations made under these Acts remain operative under this Act. It is applicable to Scotland, England, and Wales.

Secretary of State is empowered to make regulations regarding any prescribed class of goods if, in his opinion, such are required to prevent or reduce the risk of death or injury in the use of such goods. It is an offence to sell, let under hire-purchase agreement or offer on hire specified goods not complying with their relevant regulations. Local authority can authorise in writing any of its officers to test, including purchase in order to test, any goods or their component parts to which regulations apply, to ascertain if specified requirements are complied with, *e.g.* children's nightdresses, electric, gas- or oil-heaters.

Family Allowances

FAMILY ALLOWANCES ACTS, 1945–59. Applicable to Scotland, England and Wales. Subject to their other provisions these Acts require that the Minister of Pensions and National Insurance shall pay weekly to every family an allowance in respect of each child *after* the first. Eight shillings is payable for the second child and ten shillings for each subsequent child.

A 'child' under these Acts is any person who is under normal school-leaving age, and also one who has not reached his eighteenth birthday and is either attending full-time at school or is an apprentice. A handicapped child who is not at school counts for an allowance up to sixteen years. Children removed from their parents' control and detained, *e.g.* at an approved school, or committed to care of a local authority, may not count for allowances; neither may children for whom guardians' allowances, orphans' pension, or, in certain cases, industrial death benefit is payable. Ordinarily, allowances are payable to the mother but they may be paid to either parent; in other circumstances special arrangements are made. Provision is made for appeals for claims to family allowances to be made to local National Insurance tribunals.

Education Acts

ENGLAND AND WALES. THE EDUCATION ACTS, 1944–53. The principal Act is the Education Act, 1944, amended and supplemented by the Education Act, 1946, and the Education (Miscellaneous Provisions) Acts, 1948 and 1953 and the Mental Health Act, 1959. These Acts reform the law relating to education, provide for a Minister and Ministry of Education, make comprehensive provision for primary, secondary and further education, define the duties of an education authority, and with the Regulations made under the Acts contain the fundamental legislation relating to the medical and dental care of schoolchildren.

System of public education. The system of public education must be organised in three progressive stages, *viz.* (*a*) primary: full-time education for pupils below age of twelve; (*b*) secondary: full-time education for pupils over twelve and under nineteen; (*c*) further: full or part-time education for those over compulsory school-leaving age, and certain leisure time activities.

Compulsory school age. Compulsory school age means any age between five and fifteen years; the upper limit may be raised by Order in Council. The upper age limit for pupils registered at special schools is sixteen.

Provision for and attendance at educational establishments. An education authority must secure adequate provision of educational facilities in its area and this includes provision of nursery schools and classes for pupils between two and five years. The parent of every child of compulsory school age must cause him to receive efficient, full-time education suitable to his age, ability and aptitude, either by regular attendance at school, or by other means. Sickness is deemed a reasonable excuse for absence from school. Transport to and from school may be provided by an education authority.

Provision of milk and meals. A local education authority must establish a Schools Meals Service for the provision of milk and dinners for pupils. The authority may also, if they think fit, provide other meals and refreshments.

Recreational facilities. An education authority must provide facilities for recreation, social and physical training and may, with Minister's approval, maintain and manage or assist with the maintenance and management of camps, holiday classes, playing-fields and other places; may also organise games, expeditions and other activities.

Provision of clothing. An education authority may provide clothing for a pupil attending any school maintained by the authority and the parent may be required to pay for or contribute towards cost incurred.

Cleanliness. An education authority may, by written notice, authorise a medical officer to cause examinations to be made of the person and clothing of pupils at all schools maintained by it. Any such examination shall be made by a person authorised by the authority. If the person or clothing of any pupil is verminous or foul, notice may be served on the parent requiring that the pupil and his clothing be cleansed within a specified period. If the authority's medical officer considers the cleansing has been inadequate, he may make an order for it to be carried out under arrangements provided by the authority (*e.g.* at a cleansing station). If a pupil again becomes verminous or foul, parent liable to fine if condition proved due to neglect. Pupil may be excluded from school by a medical officer during cleansing period. Girls may only be examined and/or cleansed by a qualified medical practitioner or woman authorised for that purpose.

Part-time employment. An education authority has power to prohibit or restrict employment if a child is thereby rendered unfit to profit fully from education provided.

School health and dental services. An education authority must provide for medical inspection, which can be enforced, and for treatment, which cannot be enforced and must be free. The Minister may make regulations as to the conduct of medical inspections and examinations, and as to special qualifications or experience of medical officers. Every medical officer employed by a local education authority to enable them to ascertain which children should be sent to special schools for educationally subnormal children must have been approved for the purpose by the Minister.

Provision is also made for a comprehensive dental service.

Handicapped pupils. The Minister must define the several categories of children requiring special educational treatment as handicapped pupils. It is the duty of a local education authority to find out which children in their area require special educational treatment. A formal procedure is laid down for securing the medical examination for this purpose of any child who has attained the age of two, and parents have a right to be present at any such examination. If authority decides that a child needs special treatment, they have a duty to provide it either at an ordinary or a special school or otherwise, unless parents themselves make suitable arrangements.

Children unsuitable for education at school owing to a disability of mind. The Mental Health Act, 1959, amended previous Education Act provisions relating to 'ineducable' children. It is the duty of every local education authority to ascertain what children in its area are suffering from a disability of mind of such nature or extent as to make them unsuitable for education at school and may, by written notice, require a parent to submit any child attaining age of two years to medical examination at which parent entitled to be present. If such child found unsuitable for attendance at school the authority may cause this decision to be recorded and to furnish local health authority with a report on child's condition, but parent is given opportunity to appeal to Minister against proposed decision. Notice of decision to parent shall include statement of functions of local health authority regarding arrangements for treatment, care or training of child. Local health authority has power to compel attendance at training centres for such children and provide transport where necessary. Procedure is also laid down for reviewing a decision later at the instance of parent, local health authority or body responsible for management of institution where child under care, and for cancelling decision if child is then found capable of receiving education at school.

Any report issued to a local health authority under this paragraph must contain appropriate records and information relating to the child.

School-leavers requiring care from local health authorities. Children leaving school who, because of mental handicap, are in the opinion of local education authority in need of care and guidance from the local health authority will continue to receive this following the informal passage of information between the two authorities, and not, as formerly, by statutory report.

Compulsory submission to medical examination. Where a medical examination will assist the Minister to determine any question raised under the Education Acts, he has power to enforce such examination.

SCOTLAND. THE EDUCATION (SCOT.) ACT, 1962. An Act to consolidate the enactments relating to education in Scotland. The Act runs along similar lines to those governing education in England and Wales but with some points of difference in sections relating to child health.

Absence from school. Sickness is deemed a reasonable excuse for absence from school but when this excuse is put forward an education authority has the right to enforce examination of the pupil by the school medical officer.

Cleanliness. Examinations to ensure cleanliness of pupils must be carried out by the education authority's medical officer or by a person authorised by him.

School hygiene. Part of the work of the medical officers of an education authority shall be to inspect and report from time to time on educational premises, furnishing and equipment, and to have special regard to the heating, lighting, and ventilation, and the sanitary arrangements obtaining in these premises.

Handicapped pupils. The Secretary of State for Scotland must define the several categories of handicapped pupils. Provision is made for the compulsory ascertainment of handicapped children who have attained the age of five years, and for the ascertainment of those between two and five years if the parent so requests. Parents must be informed of the results of ascertainment and of the special educational treatment to be provided and have the right of appeal to the Secretary of State. The education authority must provide appropriate special educational treatment in special schools or by other means approved by the Secretary of State. Special schools include special classes, child guidance clinics and occupational centres. An authority may establish a child guidance service to study handicapped, backward, and difficult children.

Children unsuitable for education or training in a special school owing to a disability of mind. As in England, provision is made for the compulsory ascertainment of children unsuitable for education at school but with the following differences: (*a*) the compulsory age of ascertainment is five years, but a parent may request examination of child in the two-to-five-year period; and (*b*) occupational centres being classified as special schools are provided by local education authorities in Scotland. Hence a child unsuitable for education at school includes one who is incapable of benefiting even at an occupational centre, and so must be reported to the local health authority which must provide for suitable training facilities and compel attendance, arranging transport where necessary.

School-leavers requiring care from local health authorities. Where it appears that a child, by reason of mental deficiency, may benefit from local health authority services on leaving school, the local education authority must inform parent and local health authority of this fact within six months prior to child ceasing to be of school age.

Any report issued to a local health authority under the last two foregoing paragraphs must contain appropriate records and information relating to the child.

Employment and Training

SCOTLAND, ENGLAND, AND WALES. THE EMPLOYMENT AND TRAINING ACT, 1948. An Act to make fresh provision for employment exchanges and services and for training in employment.

Youth employment services. These may be provided by an education authority for the benefit of persons under the age of eighteen or over that age if still attending school. The function of such a service includes the administration of unemployment benefit. Information to be made available to the service is limited to particulars of health, ability, attainments and aptitudes; there is restriction of disclosure of such particulars, but parents have right to see such records as are submitted to the service.

In areas where the education authority does not accept responsibility, a youth employment service must be set up by the Minister of Labour and National Service.

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